LIPPINCOTT LIBRARY

AUG 29 1955

GEOGRAPHY & INDUSTRY

The EDISON ELECTRIC INSTITUTE BULLETIN

August 1955

Published Monthly by Edison Electric Institute

Atomic Energy and the Electric Utilities
Dr. Lawrence R. Hafstad

A Missing Guest
Charles Manfred Thompson

Economics of Feed Materials and Fuel Processing Problems
J. Carlton Ward, Jr.

Round Table Conference
John C. Arnell

Industry Accident Analysis
S. H. Young

ELECTRICAL RESEARCH STATISTICS
THE ELECTRIC LIGHT AND POWER INDUSTRY

Current Statistical Data Covering 100 Per Cent of Industry

(Includes Investor-Owned Companies, Cooperatives, and Government-Owned Utilities)

April, 1954-1955

SOURCE AND DISPOSAL OF ENERGY—MONTH OF APRIL

	1955	1954	%
NET GENERATION* (Kwhrs in Thousands)			
By Fuel Burning Plants	31,566,921	26,925,166	+17.2
By Water Power Plants	10,467,648	9,910,160	+ 5.6
Total Generation	**42,034,569**	**36,835,326**	**+14.1**
Add—Net Imports Over International Boundaries	363,349	70,772	.....
Less—Company Use	121,217	124,626	− 2.7
Less—Energy Used by Producer	917,149	629,930	+45.6
Net Energy for Distribution	**41,359,552**	**36,151,542**	**+14.4**
Lost and Unaccounted for	3,219,811	3,220,970	0.0
Sales to Ultimate Customers	**38,139,741**	**32,930,572**	**+15.8**

CLASSIFICATION OF SALES

NUMBER OF CUSTOMERS—As of April 30			
Residential or Domestic	43,512,798	42,231,807	+ 3.0
Rural (Distinct Rural Rates)	1,612,507	1,630,945	− 1.1
Commerical or Industrial:			
Small Light and Power	5,996,967	5,891,659	+ 1.8
Large Light and Power	277,579	273,829	+ 1.4
Other Customers	167,565	160,744	+ 4.2
Total Ultimate Customers	**51,567,416**	**50,188,984**	**+ 2.7**
KILOWATTHOUR SALES—During Month of April (Kwhrs in Thousands)			
Residential or Domestic	9,916,591	8,942,105	+10.9
Rural (Distinct Rural Rates)	927,544	755,806	+22.7
Commercial or Industrial:			
Small Light and Power	6,224,669	5,685,037	+ 9.5
Large Light and Power	19,496,272	16,027,339	+21.6
Street and Highway Lighting	333,671	310,814	+ 7.4
Other Public Authorities	816,926	763,406	+ 7.0
Railways and Railroads:			
Street and Interurban Railways	205,706	222,504	− 7.6
Electrified Railroads	168,147	179,937	− 6.6
Interdepartmental	50,215	43,624	+15.1
Total to Ultimate Customers	**38,139,741**	**32,930,572**	**+15.8**
Revenue from Ultimate Customers (Thousands)	**$644,841**	**$585,775**	**+10.1**

RESIDENTIAL OR DOMESTIC SERVICE

AVERAGE CUSTOMER DATA—For 12 months ended April 30, 1955			
Kilowatthours per Customer	2,622	2,417	+ 8.5
Average Annual Bill	$70.01	$65.74	+ 6.5
Revenue per Kilowatthour	2.67¢	2.72¢	− 1.8

* By Courtesy of the Federal Power Commission.

THE EDISON ELECTRIC INSTITUTE BULLETIN is published monthly by the Edison Electric Institute, an association of electric light and power companies in the United States and its territorial possessions. Its affiliate members consist of members of the Canadian Electrical Association.

The objectives of the Edison Electric Institute are:

The advancement in the public service of the art of producing, transmitting, and distributing electricity and the promotion of scientific research in such field.

The ascertainment and making available to the members and the public of factual information, data, and statistics relating to the electric industry.

To aid its operating company members to generate and sell electric energy at the lowest possible price commensurate with safe and adequate service, giving due regard to the interests of consumer, investor, and employee.

•

Closing date for the BULLETIN is the tenth of the month preceding the month of issue.

Manuscripts and correspondence relating to the BULLETIN should be addressed to the Editor, Edison Electric Institute, 420 Lexington Avenue, New York 17, N. Y.

The Edison Electric Institute does not assume responsibility for, nor necessarily endorse or approve, statements made by contributors to the BULLETIN.

•

Subscription price of the BULLETIN is $2.00 per year in the United States; $3.00 per year in foreign countries.

Entered as second-class matter, August 17, 1933, at the post office at Philadelphia 2, Pa., under the act of March 3, 1879. Publication office, 56th and Chestnut Sts., Philadelphia 39, Pa. Editorial office, 420 Lexington Ave., New York 17, N. Y. Volume 23, No. 8, 1955.

The EDISON ELECTRIC INSTITUTE BULLETIN

August, 1955

Vol. 23 No. 8

Articles, Speeches, Reports

Atomic Energy and the Electric Utilities
Dr. Lawrence R. Hafstad 259

A Missing Guest
Charles Manfred Thompson 266

The Economics of Feed Materials and Fuel Processing Problems *J. Carlton Ward, Jr.* 267

Eighth Annual Round Table Conference Program
John C. Arnell 275

Fatal Accidents in the Electric Light and Power industry
S. H. Young 277

Seven Resuscitation Awards Presented 281

EEI Safety Merit Award Recognizes Baltimore Co.'s Seven Million Man-Hours Record 285

News, Notes, Miscellany

Conventions and Meetings 258

Power Conference Proceedings Ready 274

Application of Equipment Handbook Revised 278

Personals 286

Rockland Light and Power Observes Lovett Plant Week 287

CONVENTIONS AND MEETINGS

1955

SEPTEMBER

11-14 Rocky Mountain Electrical League Annual Fall Convention, Grand Teton Lodge, Jackson Hole, Wyo.

12-16 IES National Technical Conference, Cleveland, Ohio.

13-14 EEI-AGA Accounting Division Organizational Meetings, Netherland Plaza Hotel, Cincinnati, Ohio.

13-14 EEI Residential Promotion Committee, EEI Headquarters, New York, N. Y.

14 EEI Commercial Division Executive Committee, EEI Headquarters, New York, N. Y.

14 EEI Home Service Committee Meeting, Detroit, Mich.

15-16 EEI Farm Group Committee Organization Meeting for 1955-56, Hotel Roosevelt, New York, N. Y.

15-18 Public Utilities Association of the Virginias 37th Annual Meeting, Greenbrier Hotel, White Sulphur Springs, W. Va.

18-19 EEI Street Lighting Committee, Cleveland Ohio

19-21 EEI Industrial Relations Round Table Conference, Drake Hotel, Chicago, Ill.

20-21 PEA Annual Meeting, Benjamin Franklin Hotel, Philadelphia, Pa.

21-23 National Industrial Conference Board Marketing Meeting, Waldorf-Astoria Hotel, New York, N. Y.

22 EEI Purchasing and Stores Committee, Planning, Rm. 1216, Consolidated Edison Bldg., New York, N. Y.

22-23 EEI Northeastern Area Dealer Coordination Workshop, New Ocean House, Swampscott, Mass.

22-23 Southeastern Electric Exchange Engineering and Operation Section Meeting, Charlotte Hotel, Charlotte, N. C.

22-23 EEI Industrial Power and Heating Group, EEI Headquarters, New York, N. Y.

22-23 Missouri Valley Electric Association Accounting Conference, President Hotel, Kansas City, Mo.

23 Oklahoma Utilities Association, Meeting of Gas Division, Oklahoma City, Okla.

29-30 EEI Transmission and Distribution Committee, Jung Hotel, New Orleans, La.

29-30 PEA Transmission & Distribution Committee, Fort Bedford Inn, Bedford, Pa.

OCTOBER

3- 7 AIEE Fall General Meeting, Morrison Hotel, Chicago, Ill.

3- 5 EEI Meter and Service Committee, Hotel Syracuse, Syracuse, N. Y.

3- 5 EEI Prime Movers Committee, Hotel Cleveland, Cleveland, Ohio.

5- 7 Indiana Electric Association Annual Convention, French Lick Spring Hotel, French Lick, Ind.

5- 7 Missouri Valley Electric Association Sales & Rural Conference, President Hotel, Kansas City, Mo.

5- 7 PIP Workshop Conference, Chase-Park Plaza Hotels, St. Louis, Mo.

10-12 EEI Area Development Workshop, Sheraton Hotel, St. Louis, Mo.

1955

OCTOBER

10-11 Iowa Utilities Association 8th Annual Management Conference, Hotel Fort Des Moines, Des Moines, Iowa

13 Oklahoma Utilities Association Eastern Electric Light & Power Division, Okmulgee, Okla.

14 Oklahoma Utilities Association Western Electric Light & Power Division, Norman, Okla.

17-18 EEI Electrical Equipment Committee, Shoreham Hotel, Washington, D. C.

17-19 Joint Meeting AGA 37th Annual Convention and Pacific Coast Gas Association 62nd Annual Convention, Statler, Ambassador and Biltmore Hotels, Los Angeles, Calif.

20 National Industrial Conference Board Meeting of Board Members, Waldorf-Astoria Hotel, New York, N. Y.

20-21 PEA Prime Movers Committee, Clearfield, Pa.

20-21 Southeastern Electric Exchange Accounting Conference, Hotel San Carlos, Pensacola, Fla.

21 Oklahoma Utilities Association, Meeting of Accounting Section, Lawton, Okla.

24-26 37th Annual Meeting ASA and 6th National Conference of National Bureau of Standards, Shoreham, Washington, D. C.

24-27 NARUC 67th Annual Convention, Grove Park Inn, Asheville, N. C.

26-28 National Industrial Conference Board Special Atomic Energy Conference, Waldorf-Astoria Hotel, New York, N. Y.

27-28 PEA Electrical Equipment Committee, Hotel New Yorker, New York, N. Y.

27-28 Southeastern Electric Exchange Sales Conference, Biltmore Hotel, Atlanta, Ga.

31-Nov. 1 PEA System Planning Committee, Pocono Manor Inn, Pocono Manor, Pa.

NOVEMBER

3- 4 EEI-AGA Taxation Accounting Committee, Plaza Terrace, Cincinnati, Ohio

9-10 Pacific Coast Electrical Association, Conference Hawaiian Section, Honolulu

13-18 ASME Diamond Jubilee, Congress-Hilton-Blackstone Hotel, Chicago, Ill.

14-16 EEI Accident Prevention Committee, Beaumont Hotel, Beaumont, Texas

17-18 EEI Industrial Relations Committee, Joint Meeting with New England Personnel Group, Somerset Hotel, Boston, Mass.

21-23 Wisconsin Utilities Association, Electric & Gas Section, Schroeder Hotel, Milwaukee, Wis.

DECEMBER

11-12 EEI-AGA 1956 Conference Planning and 1957 Time & Place Committee Meeting, Headquarters, New York, N. Y.

15 EEI Industrial Relations Committee, EEI Headquarters, New York, N. Y.

The EDISON ELECTRIC INSTITUTE

BULLETIN

Atomic Energy and the Electric Utilities

By Dr. Lawrence R. Hafstad

Director, Atomic Energy Division, The Chase Manhattan Bank

An Address before the Twenty-third Annual Convention of the Edison Electric Institute, Los Angeles, California, June 15, 1955

NOT many years ago, in addressing groups of utility management and engineers, it was my custom to dwell on the atom, explaining how energy was extracted from the atom, and discussing the technical problems in connection with atomic power reactors.

It is a significant measure of the rate of progress made in this field in the last few years that a discussion of this type would be superfluous for as informed a group as this.

Thus, I do not propose to discuss the technical problems of atomic power reactors. Rather, I will touch on the problems of the atomic power industry in which the electric utility industry is inescapably destined to plan an ever-increasing role.

It is to the credit of this organization, and to the leadership that this organization has given to the electric utility industry, that in a few short years the aura of awe and mystery surrounding the use of atomic energy has been dissipated and you are now fully prepared to take in stride the problems associated with the use of this interesting and potentially cheap new fuel source.

The question no longer is whether or not atomic energy is real. The question is: is it practical? If not practical now, is it likely to become practical in the future, and if so when?

Most of us here know that atomic power for civilian use is not now practical in this country in the sense of producing electric power at a cost equal to or lower than power from coal or oil, blessed as we are with large reserves of fossil fuels. Similarly, this group is sufficiently informed not to be misled by science fiction stories of pocket-sized atomic house warmers and atomic-filled gas tanks for automobiles. I will not waste your time discussing these things here.

DR. LAWRENCE R. HAFSTAD

Many of you, however, may be somewhat confused by the many different types of reactors being developed, by the variety of cost figures which are quoted, and by new government regulations and procedures. On these points I may be able to make some comments helpful to you.

Finally, I will give you my impressions of progress in regard to President Eisenhower's exciting "Atoms-for-Peace" program and indicate how in addition to the direct values of this program, some of its by-product values should be of special interest to you as utility operators.

Turning first to the question of the variety of reactor types being developed, I believe it helpful to break down the entire program in which this country is engaged into sub-programs. In that way the problems and prospects of these sub-programs can be separately considered.

The first such program I would consider is the military propulsion reactor program. The significant point here is that being a military program, the cost factors are not so compelling as they are in civilian power-reactor programs. Effectiveness and not efficiency is the measure of a military weapon. It is for this reason that the Nautilus is successful in spite of its high cost, and I think we can fully expect a continuous and increasing program of power reactor development for military propulsion purposes. This is important because in this way bold new steps toward improved technology can be taken, and, on the basis of this new development, better methods of using atomic energy can be developed for civilian use.

Another by-product value of the military program is that in addition to developing technology, we are training personnel. This, too, is of importance to our civilian program because we will need all the trained personnel we can get as civilian use of atomic energy grows by leaps and bounds some time in the future.

This sub-program, then, is underway. It is successful. And it will doubtless increase in the future more or less regardless of further reductions in cost. The technology is good enough to earn its keep at the present time.

Five-Year Program

The next sub-program that you should consider is the Atomic Energy Five-Year Program for Reactor Development. This is largely a government-financed activity. It is strictly research and development and none of the reactors produced here were intended to produce competitive

power. Many of the plants will produce power, but it is important for you to realize that the cost comparisons in this program are not particularly significant because the goal was to gain information, not to produce low-cost power. In this program there are very high development costs. Again, don't be misled by these high development costs. They are associated with any new, radical development.

To emphasize this, I would like to cite development costs of some similar but more conventional items. Many people do not seem to realize how high development costs are. I would like to cite the electric blanket which is simply a wire covered by woolen cloth. How much would you suppose it cost to develop the electric blanket, an item which costs about $25? The answer given to me by the General Electric Co. is $1.5 million.

Waste Disposal

Another example is the simple waste-disposal system of a kitchen sink that costs perhaps $50. Development costs on this were about $7 to $10 million.

This indicates how high development costs are on new products. It should not surprise you, then, that development costs for material for devices as complicated as reactors—each one of which may cost $10 million or more—should be very high indeed. The point I want to make about the Commission's experimental reactor development program is that the costs are not intended to be competitive.

One more point concerning this program: one of the major omissions in it—and it was done for economy reasons—was that no small reactors were included in this program, the reason being that atomic engineering is most economical on a large scale. We like to build large plants in order to reduce the unit cost. However, the total cost of the large plant is, of course, still much greater than the total cost of the small plant and we could get much more experience with a large number of small plants than with a few big ones. I will come back to this a little later, but I think it is important that all of us realize that there is still a hole in our over-all national program. Not enough emphasis has been given to small plants.

Now we come to the third major program—the power-reactor demonstration program. This is really a new major development in the atomic energy field. It shows industry's conviction that atomic energy is here to stay, because in this program industry is carrying most of the burden of financing. Many of you may not have had time to read up on atomic energy. The most convincing story I could cite, as to why it is that sooner or later the utility industry will have to be prepared to use atomic energy, is given by Harrison Brown in his book, "The Challenge of Man's Future." This I suggest to you as background reading.

The important thing to remember is that sooner or later the utility industry will have to look to atomic energy to supplement its fuel reserves. This is the reason why the leaders in this industry have seen fit to take part in this power-reactor demonstration program, even though all of them know that this is not a money-making and probably a money-losing operation.

From the government's viewpoint, this program, too, represents tremendous steps. It certainly proves that statements by government officials to the effect that they want private industry in this business are not empty phrases. It is an excellent example of a government monopoly—contrary to the usual practices of a bureaucracy—giving up its powers and sharing its information with private industry. I believe this is one instance where we should give the Atomic Energy Commission full credit for its actions in making this information available to a wider section of industry.

As most of you know, four proposals for building power reactors are being considered by the Commission at the present time. In all of these the main part of the financing is carried by private industry with government assistance to a greater or less extent in each case. Decisions are yet to be made whether all or which of these proposals are acceptable to the government. I think that the action taken here by the government will give us a good measure of the convictions behind the government's claim that it wishes to get private industry into the atomic power business.

It certainly is my hope that all of these proposals will be accepted so that the industry can move along vigorously in this new field. I will come back to this problem later in connection with the matter of reducing costs.

I might mention here, however, that all of these reactors are essentially large reactors. As I indicated before, there is room for a similar program on the same partnership basis for developing power demonstration reactors smaller in size—perhaps 10,000 kw.

These four atomic power proposals advanced by industry raise a host of new problems. This, I believe, is healthy, because only when our noses are pushed up against these problems do we really begin to take them seriously. In a brief discussion, I can do no more than list some of these problems and emphasize why they are important.

By all odds, of greatest importance is the fact that this new program has made industry and the utility management people cost-conscious, and it is obvious that how these costs are accounted for in your bookkeeping will help determine what they amount to in dollars and cents. This, too, is healthy because industry's critical attitude toward costs will help the government assess costs on a realistic basis.

Insurance

Another important new question is that of insurance. All of you know there are peculiar new hazards connected with the atomic energy industry, and insurance for these new hazards will require, I believe, an amendment to the Atomic Energy Act.

My feeling is that we have had enough experience with reactors so that insurance companies, through normal channels, will be able to provide insurance for all the normal small risks and the hazards incidental to operating reactors. It is conceivable — but extremely improbable — that an accident might occur in which the total liability would be very great. This kind of risk requires the broadest possible insurance base, and it seems to me that the way to get the broadest base would be for the government to reinsure the insurance companies in some manner similar to that of the War Risk Insurance Act, with which we have had considerable

experience. So something needs to be done about the insurance problem before industry can really get into the atomic power field.

Two other important problems are chemical processing and waste disposal. Of these, I will only say that it is the hope of many of us that these waste materials will find uses and become a valuable by-product rather than a total loss as they are at the present time. I think recent experience in the research and development field has indicated several methods of possibly accomplishing this.

Industry's Contribution

Let us turn now to the question of industry's contribution to the power-demonstration program. I use the word "contribution" advisedly, because this is not an investment. It is not an investment in the sense that you are uncertain of the risks and expect to get proportionate profits at some time in the future. For the immediate future, any industry participation in developing power-demonstration reactors must be looked upon essentially as a contribution.

This suggests to me that the arrangements between industry and the government must be much like the partnership deal which James B. Black, Chairman of the Board, Pacific Gas and Electric Co., has discussed. (Page 213, July, 1955, BULLETIN.) The advantage in this is that the total cost to the taxpayer should be considerably smaller in such a partnership arrangement than it is in a completely government-financed program.

Such a program, however, is not the beginning of a chain reaction leading to more and more reactors being designed and built—something very important to the supplier's view. This is an economic hurdle we have to get over. The supplier cannot provide the money for the facilities—production facilities needed to supply parts in quantity—until he is sure of a market. This market cannot develop until there is a chain reaction initiated whereby the first reactor makes a profit, other people see that it makes a profit, build more reactors, and more reactors further reduce the cost. This makes it possible for other companies to get into business and at that point we are off to the races.

I do not see such a thing happening in the immediate future, even based on the considerable market for parts created by this demonstration-reactor program. We need a bigger market than now foreseen for our suppliers if we are going to reduce costs sufficiently to start using atomic energy for civilian purposes in this country in the near future.

In connection with costs, I would suggest that you keep in mind two things: one, of course, is the plant cost in dollars per kilowatts of capacity with which you are fully familiar; the other is the operating cost, and especially in the utility business, the fuel cost.

The situation in the latter case is somewhat confusing because many of the figures quoted publicly seem to indicate that atomic power is already competitive. If this were true, many companies would be moving much more vigorously into the field than they are at the present time. I believe this confusion arises from the fact that the relatively low costs often quoted are essentially extrapolated costs which people hope to attain if and when fuel technology and chemical technology are developed to such an extent that it becomes a quantity operation.

Actual Operated Plant Costs

The actual costs with which we are now struggling come from the plants that we have already operated. These consist of the military projects and the few plants with which we have had real experience in the civilian program. These costs have been high. This is all I can say about it because the exact figures are classified and cannot be made available to groups which have no special clearance for the information.

Confusion Responsibility

This restriction is responsible, I believe, for the confusion that results when low extrapolated costs are mentioned publicly while those of us in the business are struggling with the high costs connected with the actual reactors under construction. It will help clear up this confusion if you, as utility management people, take advantage of the new Access Agreement Procedure which the government has set up. You will recall as of the last five years or so, that utility people have been able to get access to classified information by agreeing to a study program. However, this has required the investment of substantial amounts of money and the assignment of a relatively large number of valuable people.

Under present arrangements, the Access Agreement is available with much less red tape. Very significant is the fact that the Access Agreement refers only to confidential information and not secret information, therefore requiring only a limited clearance instead of the full background investigation, or Q clearance, which was required in the past.

Access Agreement

For this reason, I believe all of you who have a legitimate interest in these cost figures should take steps to make sure that you get, either individually or in combination, access to these figures through an Access Agreement. If and when you have such an Access Agreement, you will be given all of the cost figures which are available. This will help you considerably in assessing what the situation really is in regard to fuel costs.

Since you will have very many different fuel costs given — different costs for different reactors—my recommendation would be that we persuade our suppliers to give us fuel costs on a broader basis than usual. The most convenient way I have found to use these figures is on a cents per billion Btu basis. This would afford a least common denominator so we could compare costs for different reactor types so far as over-all fuel types are concerned, and we could compare nuclear fuel costs with conventional fuel costs all over the world.

I have some figures that are unclassified which I found very useful. I think we should have them substantiated and probably should have corresponding figures from various suppliers, but to give you some baseline from which to measure progress, here they are:

Material costs alone for the nuclear fuel should be about ten cents per million Btu, but this is by no means the whole story. Coal is ready to burn when you buy a ton of coal, but uranium is not as ready to be used in a nuclear reactor. So, to this material cost it is necessary to add fabrication costs—about 15 cents per million Btu,

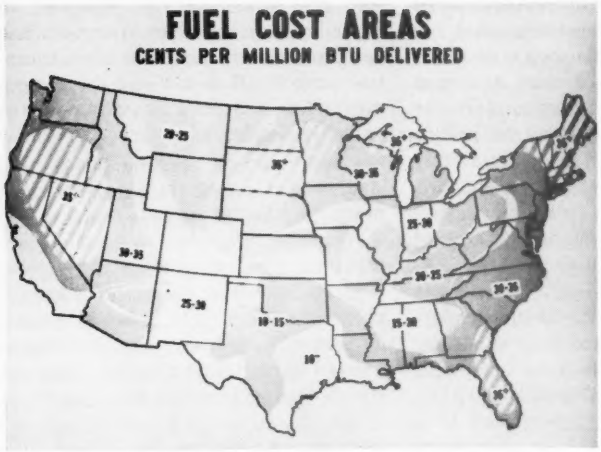


Figure 1

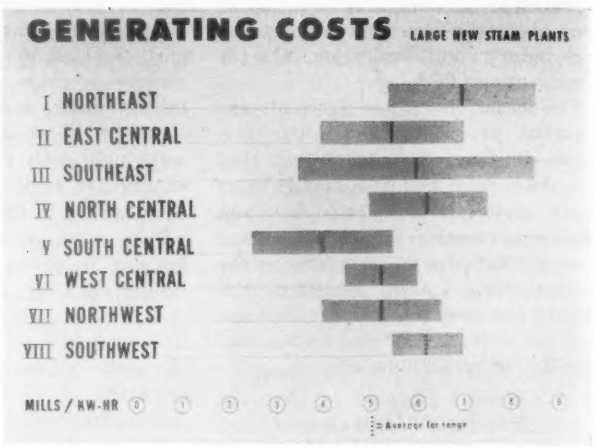


Figure 2

giving us a total fuel cost of 25 cents per million Btu.

I can't certify the accuracy of these figures, but they do give us a general idea of costs at the present time. They seem to be on the high side as far as fuel costs are concerned, and I think this is really what the situation is.

Now, I would like to emphasize by illustrations some of the points that I have made.

Distribution of Fuel Costs

Fig. 1 is familiar to most of you and shows merely the wide distribution of conventional fuel costs around the United States, running from ten cents per million Btu delivered in Texas to 35 cents in New England, and rising higher in several other places in the nation. With these figures we must compare the cost of nuclear fuel. The important thing with nuclear fuel is that the low transportation costs should iron out the differences and make fuel costs essentially uniform throughout the United States, or for that matter, throughout the world.

Fuel Costs Translated

Fig. 2 shows these fuel costs translated into power production costs, separating costs of the power by geographical range. The significant thing here is that transportation costs are important.

Different Reactor Types

Fig. 3 is intended to show you that there are many different reactor types. One group, the natural uranium type up on top, lends itself to very large reactors. There are many different fuels and moderators that can be used as well as different structural materials. For each of the types of reactors, uranium can be slightly enriched or highly enriched, as you have several variations in technology. It is this large number of commutations and permutations that makes it necessary to explore different reactor types.

Experimental Program

Fig. 4 gives same data on the Commission's experimental five-year program. You will notice that 60,000 kw is going to cost about $85 million. This has been reduced somewhat since the chart was made, but still is high. Similarly with smaller units, the cost per kw of capacity is very high. These are strictly experimental reactors.

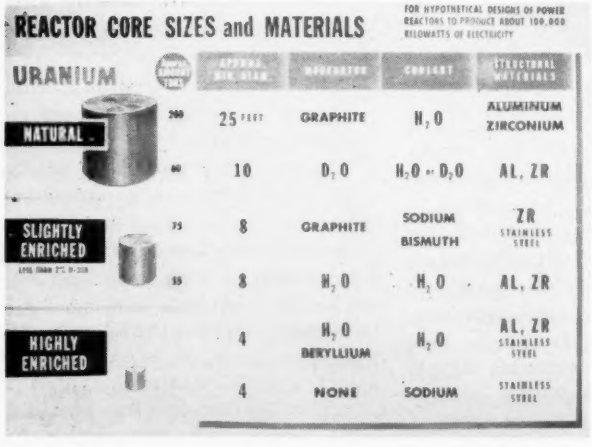


Figure 3

MAJOR PROJECTS OF FIVE APPROACHES TO INDUSTRIAL NUCLEAR POWER

PLANT	DEVELOPER	POWER		COST
		HEAT	ELECT	MILLIONS
Pressurized Water Reactor	Westinghouse	264,000 KW	60,000 KW	$85
Experimental Boiling Water Reactor	Argonne	20,000	5,000	17
Sodium Reactor Experiment	No. American	20,000	none	10
Experimental Breeder Reactor No. 2	Argonne	62,500	15,000	40
Homogeneous Reactor Experiment No. 2	Oak Ridge	3,000	yes	47
Homogeneous Thorium Reactor		65,000	16,000	

NOTE: Preliminary Data and Estimated Costs for Research and Development, Operation and Construction; Fiscal Years 1954-58, Inclusive.

Figure 4

Fig. 5 shows the very large number of different types of reactors with which we have had experience. Several main lines of advance are the homogeneous, way over on the left-hand side; the liquid metal reactors, graphite reactors, light water reactors, and, over on the right-hand side, the heavy water reactors. The significant thing here is that the total number of reactors operating or actually under construction is about 30. Some of these reactors have been working for ten years or more, so the total number of years of experience has become significant.

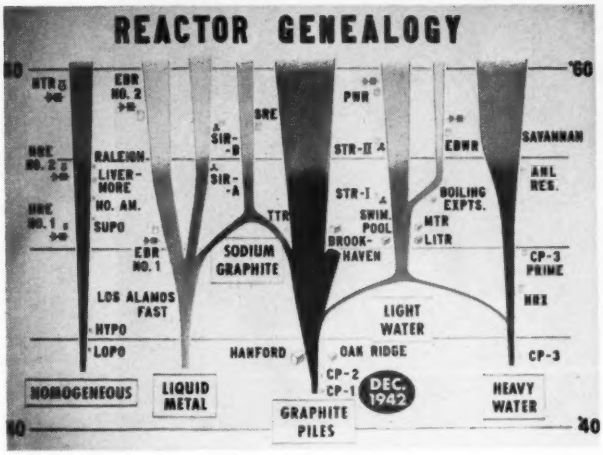


Figure 5

Atomic Industrial Forum Study

Fig. 6 relates to cost and results from one of the studies by the Atomic Industrial Forum. In the left upper portions is the estimated generating cost of nuclear power in mills per kwhr for small reactors, and for large reactors below. You will note that the costs run very high in 1955-56, which is the year figure of the lower left-hand corner. It is expected that these costs will drop rapidly as technology is advanced and when volume production begins, but this has not as yet been demonstrated. Here I think you see the reason for the differences in the cost figures which have been quoted. It makes a lot of difference if the figure is a demonstrated cost figure, or a hopeful cost figure at some future time.

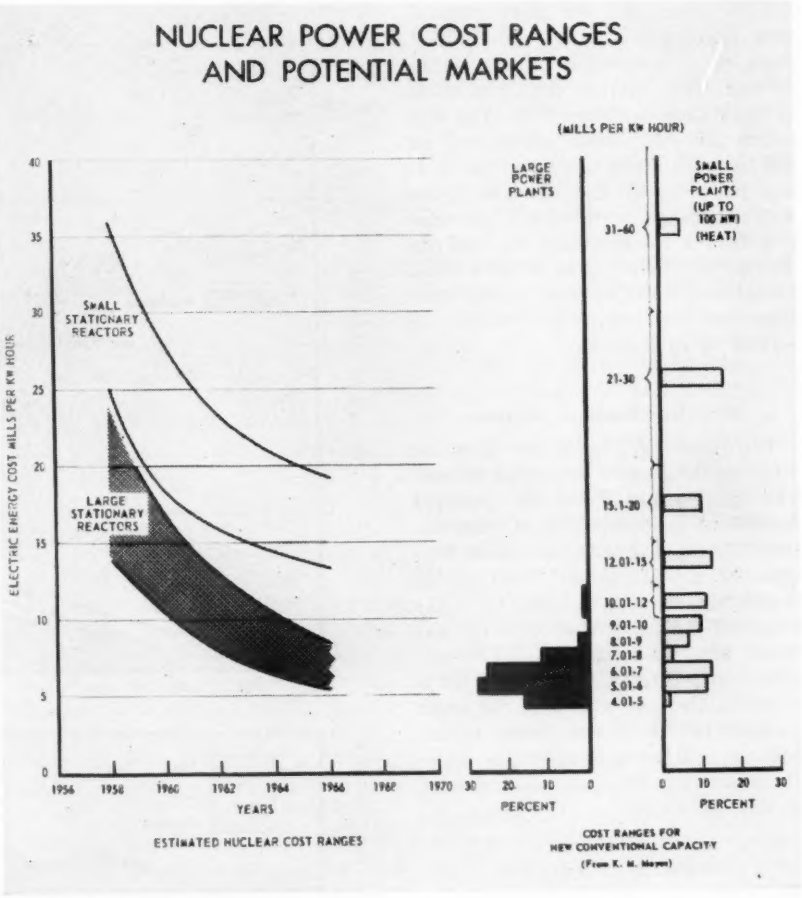


Figure 6

Construction Cost Trends

Fig. 7 shows reactor construction cost trends (per kw of heat) on the basis of past experience. There are two groups of reactors here—research reactors and power reactors. The important point is that the trend is definitely downward. On the right-hand corner is a shaded portion which indicates the comparative construction costs (per kw of heat) of conventional generating plants and shows the cost we have to attain before we have competitive power costs. This will require extrapolation and it is this extrapolation which indicates the uncertainty in the future cost of nuclear power and the time at which it will be obtained.

Significant Relative Figures

Fig. 8 is a more specific chart of the same kind. It shows the cost of the heat energy in cents per million Btu obtained from actual fuel ele-

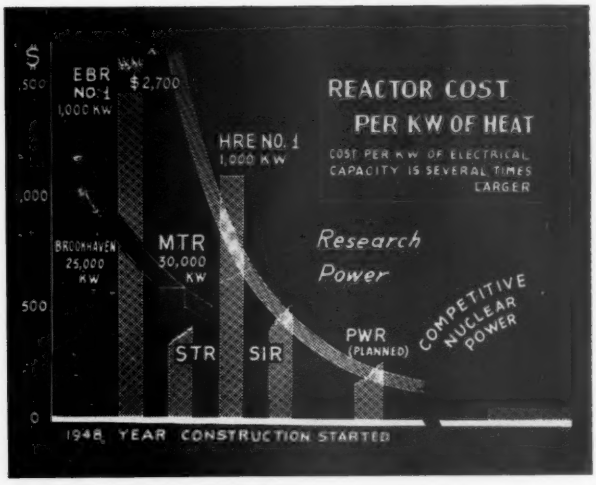


Figure 7

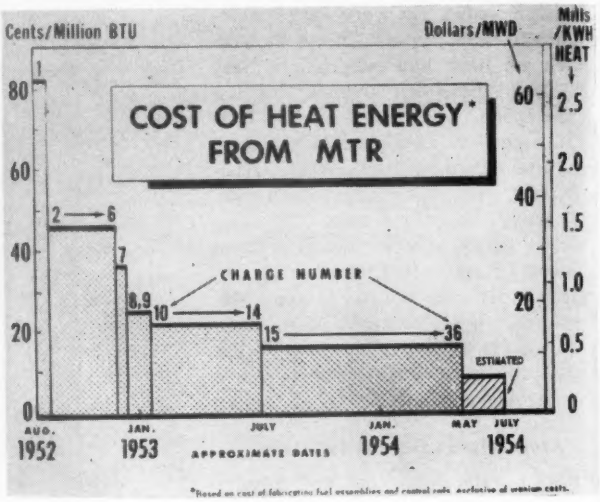


Figure 8

ments, exclusive of uranium costs, in the Material Testing Reactor. You will note the first charge was quite high—about eighty cents per million Btu. As we gain experience in manufacturing, and I don't mean on a great-scale volume manufacture, large savings should be made as the volume is stepped up. You will notice the cost comes down and we end up with about ten cents per million Btu. Again, the absolute figure does not means too much but the relative figures are significant in showing that in this industry as in all normal industries, costs do come down with improved technology and increasing volume of production.

Expected Business Volume

The charts in Fig. 9 are from the study of the Atomic Industrial Forum. The upper chart shows the expected volume of reactor business, starting from the present time and proceeding into the future. About 1960 or '70 the abrupt rise starts. This is on the assumption that, at that time, nuclear power becomes competitive. This situation may or may not develop. If it develops, then we will start the chain reaction which I mentioned earlier and we will have a relatively large atomic-reactor business as indicated in the upper chart.

Minimum Presentation

In the lower chart is a minimum presentation of the same kind of information. Here the significant thing is that the cross-hatched portion

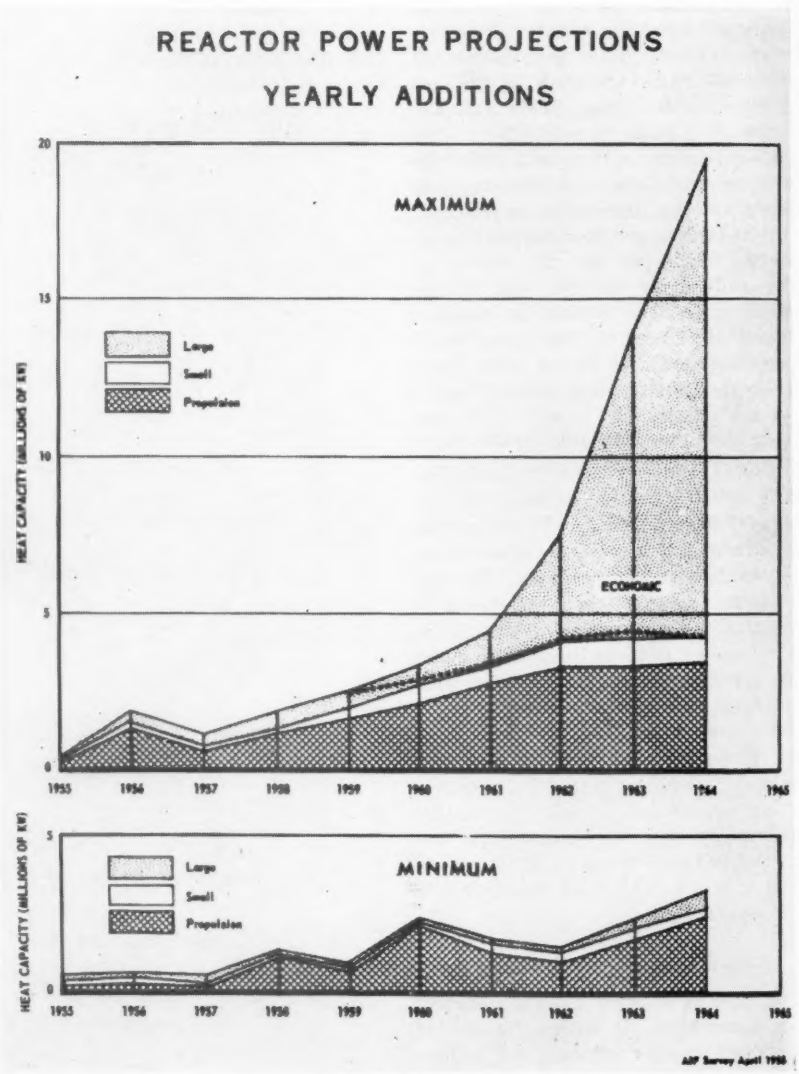


Figure 9

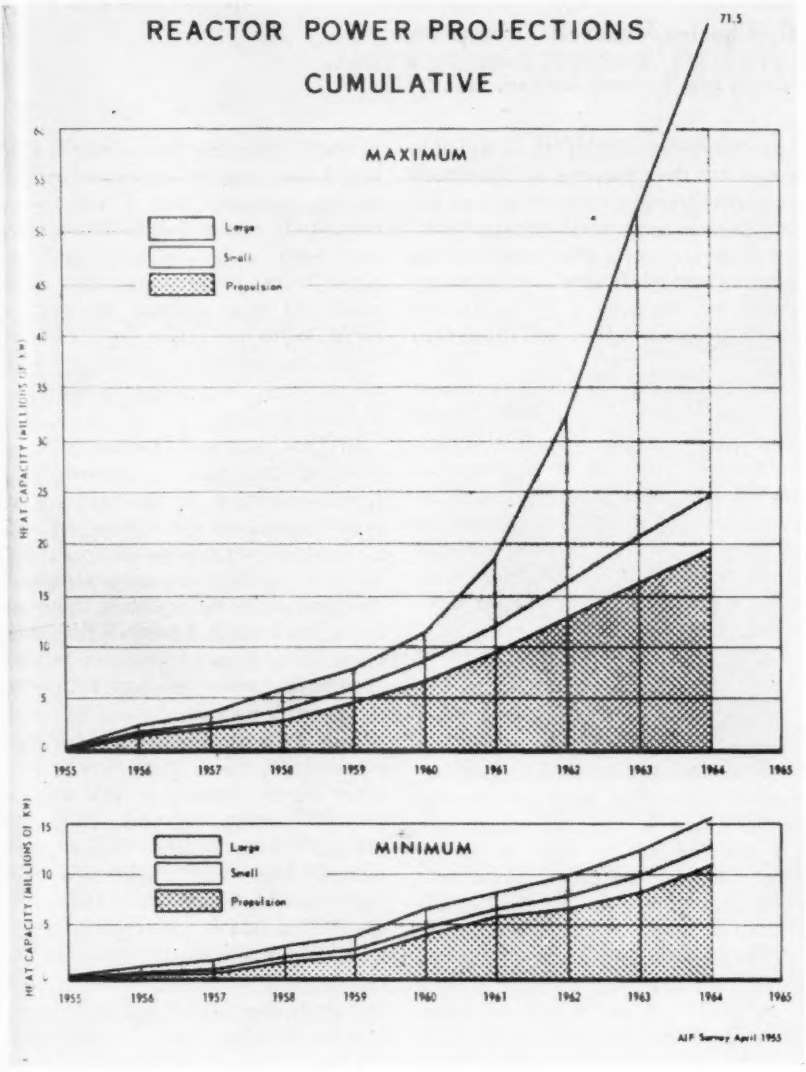


Figure 10

which represents the propulsion-reactor program continues with not too great a change. However, the civilian program is very much reduced on the assumption that it will take longer to attain competitive power than was anticipated in the upper chart. There is a wide discrepancy between the two charts, but I think we should be prepared for this difference and face it realistically.

Cumulative Basis

Fig. 10 is much the same sort of thing except on a cumulative basis instead of an annual basis. But again you will notice a big difference between the maximum and minimum programs.

Now the point I want to draw from these last several illustrations is that unless we can get a volume business of some kind, a real market for reactors, it will not be possible for the suppliers to set up production tooling and get costs down. There are several ways in which we can develop this market.

We can ask for and hope for more government research and development funds in exploring these new technologies, and we can continue with industry contributions as have been made in connection with the power reactor demonstration program. This will give a reasonable market, but again it will not start off a chain reaction.

What about the foreign market? Will that help?

Incentive from Foreign Market

The future power requirements for the U. S. are so very large that in the long run it will be the big market in any case, but it is entirely possible that, temporarily, if we get even part of the foreign market for our suppliers there will be enough incentive, enough business generated, to justify their setting up production tooling. This may serve to reduce the costs to the point where reactors might be competitive in this country.

It is for this reason that I think you, as utility management people, should have an interest in the foreign market even though your business is domestic. Our suppliers need help in getting the costs down to the point where they can do business with you.

"Atoms for Peace"

The Eisenhower "Atoms-for-Peace" program has tremendous political appeal. I was surprised in my visits to other parts of the world how the general public in foreign nations has taken to the Eisenhower "Atoms-for-Peace" proposal. It seems that in foreign countries, as here, people are hoping that, somehow, the atom can be turned to useful constructive purposes, and there is much hope that this will be done in the immediate future. This is a goal to which we must turn our best efforts.

As a by-product of this, however, I think it is entirely conceivable that our manufacturers and suppliers may be able to sell abroad, first research reactors, then small power reactors, and perhaps eventually large power reactors, as can be done under the bilateral agreement arrangements which are now being made by the government in Washington.

Small, Significant Market

This will at best be a small market but in the over-all program may have a significance far beyond its size. If this market should open up promptly, it might help to hold in the atomic energy business, some of the smaller companies especially, which for lack of business and prospects seem likely now to throw in the sponge.

A Missing Guest

By Charles Manfred Thompson
Dean and Professor of Economics, University of Illinois
Reprinted from *Economic Overtones*, June, 1955

RECENTLY, I described a Christmas party held in my study for a group of servants that had been with me for many years. I neglected in my description, however, to say that several of the most faithful ones could not attend, for to have abandoned their duties for even a moment would have thrown the household into confusion.

While those at the party were enjoying themselves by relaxing from their accustomed tasks, the one I failed to mention in my earlier story of the party were going about their work as usual; and this they were doing without audible complaint or inward resentment. One of them I shall discuss in this connection. This servant is electric power—a servant ever present and omnipresent.

It goes about its work with no fanfare whatever, and, on those rare occasions when, for good and ample reason, it idles. I know from long and intimate experience that shortly it will resume its duties with an alertness that has come to be a hallmark of excellence. Like other American households, the demands made by mine on electric power cover a wide range of service reaching from an electric razor through many lights to various kitchen accessories. Some of the demands thus made are relatively light and far apart in time, but light or heavy, frequent or otherwise, they are met instantly and with full sufficiency.

Finest Loyalty

Yet, in the face of the finest loyalty to be found anywhere, we, as power users, fail to appreciate, as we should, what is being done for us. Being human, we take such loyalty for granted. What we need, I sometimes think, are frequent interruptions. Then, I am sure that the very absence of such faithfulness would bring us around to a proper appreciation of its presence.

I am one of those who hold in the highest esteem the labors of the men who have spent their lives delving into the mysteries of this invisible giant and then passing on what they have discovered to men of affairs for purposes of commercialization. Without them and their kind, much of the genuine materialism we enjoy today would not be even a dream in the minds of most of us. All honor to them!

But in singing the praises of these pioneers, I am not unmindful of the part other men, and women too, play in keeping this giant strong and healthy. Without them, much of the manifestation of electric power, as we see it all about us, would be little more than a laboratory show piece to be displayed only on special occasions. All honor to them!

Continuity of Service

Those responsible for supplying electric power have done more than to adapt laboratory results to practical needs; they have gone much farther, and so far as anyone can see the end of the road is not in sight. Of all their contributions—there are many—the one that stands out in my mind concerns continuity of service. Without such service the social and economic benefits arising from their efforts would be spasmodic and undependable, and hence a reflection on wise management. Here is the crux of the matter.

Electric power is in the hands of wise management — a management that realizes its responsibility to provide at all times, and all the time, the service it has to sell. This wisdom never relaxes for a moment; it is wide-awake to the needs for a continuous supply of current in any amount demanded, at any point, and for any purpose. All this calls for sympathetic understanding when, on rare occasions, the giant that makes modern life so livable seems to be shirking his duty.

A second important item merits attention; it has to do with rates. Those of my generation know, from experience, something about the charges for power years ago. When, in 1901, I paid my first electric light bill, I felt (and so expressed myself to the cashier) that I was being robbed. In a way I was. The service had been unsatisfactory, and the rates were high, especially when measured over against the cost of using kerosene lamps and candles. From that point on, necessity forced me to keep a sharp eye on the price of light service.

In time this cost declined. Rates were on their way downward, their speed depending, in the main, on improved operating conditions. All this I observed with keep interest, for, while I was wholly unacquainted at the time with the reasons involved, I did know that I was being more than fairly treated by an organization then under sharp scrutiny by the general public.

As I view these early experiences, I know full well that, even then, what I was getting in the way of electric service was relatively low priced. Likewise, present rates, viewed from any angle, are even lower—much lower—than they were then. The power and light costs in millions of American homes today reflect this situation when placed alongside the costs of tobacco, liquor, and/or entertainment. Budget-wise, the cost of a few gallons of gasoline is greater, and hence bulks larger in the budget, than that spent for power and light by the typical American family for a week's service.

Tireless, Ever Present

It must be clear, then, why I regard so highly this servant of mine. He never tires, is ever present in more than a hundred fifty places in the home, and his maintenance costs are low. My father never enjoyed, without apparent hurt, this association, but I must confess that it is one of the last I would be willing to break.

Numerous phases of operation—generation, transmission, and distribution—are involved in the reduc-

(*Continued on page* 288)

The Economics of Feed Materials and Fuel Processing Problems

by J. Carlton Ward, Jr.
President, Vitro Corporation of America

An address before the Twenty-third Annual Convention of the Edison Electric Institute, Los Angeles, California, June 15, 1955

THERE are phases of the subject of feed materials and fuel processing which remind me very much of the problem of the homeowner when his house is undergoing repairs or reconstruction. When the plumber and the carpenter and the painter go home the home-owner finds strewn through his house the chips and the shavings, the stepladders, barrels, sawhorses, old paint cans, and all the odds and ends of the workmen's labor. The owner looks at all this confusion, removes the very obvious objects, and has the almost irresistible inclination to sweep all the little pieces to the center of the room and pull the big rug over them. That is about the position this subject is in. In the broad field of nuclear power it has had the rug pulled over it, because it is a very complex, tiresome, and unglamorous part of the over-all problem.

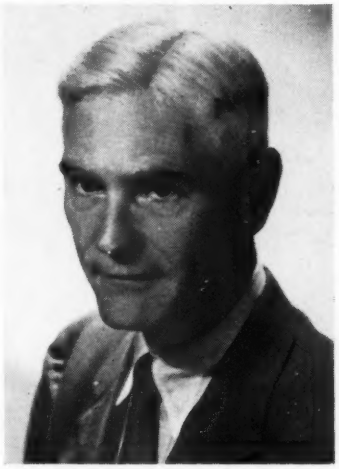
As a preliminary to discussing the cycle of fuels let us have a brief look at the ecnomics involved.

Economics of Atomic Power

As atomic energy enters the field of power in the United States we all know that there will be changes in the economics of power production. What these changes are can in some instances be fairly well estimated—in others they are pretty much an unknown quantity. Probably the greatest change in the economics of power production, however, will be in the area of feed materials and fuel processes for nuclear reactors.

In a broad sense, there are three general cost factors in the economic picture of any power generating system. These are capital costs, fuel costs, and operating costs.

Although we are not primarily concerned with them in this presentation, *capital costs* for the nuclear reactor plus the power generating plant and distribution system, are more accurately predictable than operating costs at the present time. This is true because the power distribution system is either standard or closely allied to present practice, and only the cost of the reactor and its auxiliaries are guesstimates. Even so, the cost of construction of a reactor plant is more amenable to conventional cost estimating because, once a design is chosen, rather firm approximate dollar figures may be developed from existing cost experience on major component items. Such estimates that have been prepared indicate the cost of power per installed kilowatt capacity will range from $200 minimum to $400 maximum per kw. These costs are, in general, higher than for present day conventional plants and will, presumably, remain somewhat higher for a while.



J. CARLTON WARD, JR.

So far as the *fuel costs* go, they are in general reasonably negligible compared to those of the conventional coal-fired plant, especially if we are considering a breeder-type reactor.

But the third factor, the *operating costs* of an atomic reactor, particularly fuel handling, which includes reprocessing, can be much higher than the operating costs in a conventional coal-burning plant. The test which nuclear power reactors will have to pass is economy in the over-all reprocessing of their fuels.

We should like to consider here some of the aspects of this complicated reprocessing problem, so that we can see why the costs are high. Furthermore, we should like to remind all those who are interested in the future of atomic power that the necessary factor of reprocessing is an integrated part of the nuclear system, and an extremely important one.

It is primarily in this area of fuel preparation and processing, which includes costs of feed material, fuel element fabrication or solution preparation, separations, reprocessing, and fission product disposal, where the technology of commercial sales experience is lacking at the present time for the preparation of good cost estimates. However, it is in the continued development and experience—both in experimental and actual plant practice—of feed and fuel problems that they will yield data which will grow consistently closer to accurate cost analyses.

Realizing that these areas represent, to a large extent, the operating costs of nuclear power, one can see that its competitive position with reference to conventional coal-fired power will be better defined as the true costs of nuclear fuel preparation and reclamation are developed in practice.

Before we examine the picture of atomic fuels, however, let us first see where such fuels stand in relation to all fuels.

Atomic Fuels vs. Conventional Fuels

Chart 1 on world energy requirements was prepared by Dr. A. C. Monteith of Westinghouse Electric

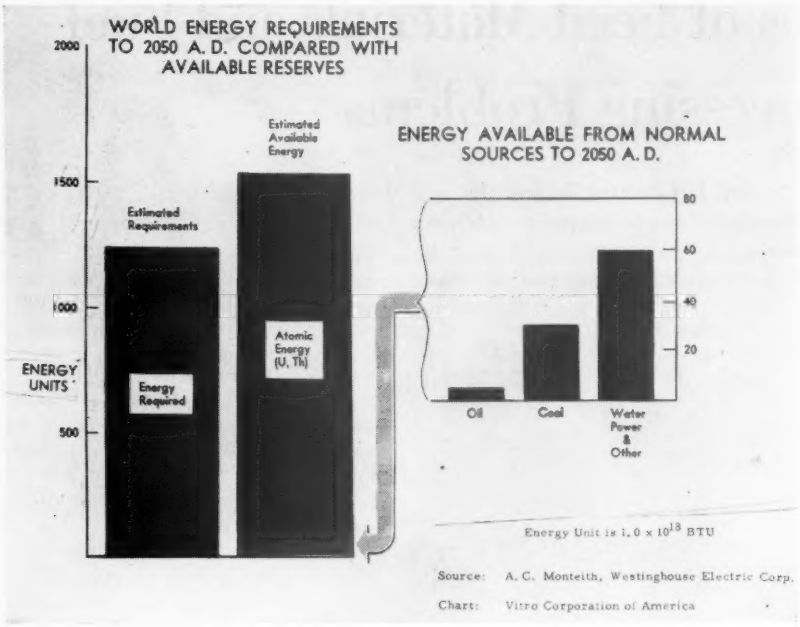


Chart 1

and dramatizes the relationship of nuclear fuels to the better known fossil fuels we are now using.

You will note on the left that the estimated energy requirements for the world for the next 95 years are about 1250 energy units. On the right side of the chart are the amounts of oil-developed energy, coal-developed energy, and the other energy, from water power and all other sources. You will note that all three together total somewhat less than 100 units, just a small part of the total of about 1550 units of estimated available energy—all the rest of which is in the form of atomic energy fuels, uranium and thorium. It has been estimated and stated in official Atomic Energy Commission reports that our available energy in this form is roughly 25 times the amount available from fossil fuels. You will note that the expected shortage of fossil fuels, plus water power, will leave us with an exceedingly serious problem not too far hence. So the economy of nuclear fuels in the long run is less important than the necessity for nuclear fuel as a power source. In this regard it may be later than you think.

The Picture of Nuclear Development

Chart 2 is a simplified scheme for the over-all problem of furnishing atomic power and illustrates the relationship of the various factors.

This chart requires no explanation, but it indicates how the fuel enters the reactor cycle, after its various steps of mining, milling, processing and refining, and how the reactor cycle is then responsible for its three principal products: electric power, weapons, and radioisotopes for industry, agriculture, medicine, and so on.

Feed Material and Fuel Preparation Cycles (Fuel Cycles)

Let us now examine the picture of feed materials and fuel processing in more detail. The term "fuel cycle" is used to designate the major steps in the flow of fuel materials from the mine through operation in a reactor to eventual fission products and waste disposal.

The major steps of the fuel cycle are:

1. Raw Materials Preparation—Mining, Milling, and Concentrating.
2. Feed Material Preparation—Reduction to Metal.
3. Fabrication of Fuel Elements or Preparation of Fuel Solution.
4. Operation in Reactor.
5. Reprocessing—Decontamination and Metal Recovery for Return to Fuel Refabrication.
6. Disposal of Waste Products—Fission Product Utilization.

A fuel cycle for a specific reactor plant involves some or all of these major steps in varying degree. We can follow them more easily by referring to Chart 3, which is a scheme for a hypothetical nuclear power complex.

What are the raw materials? They are, simply, uranium and thorium.

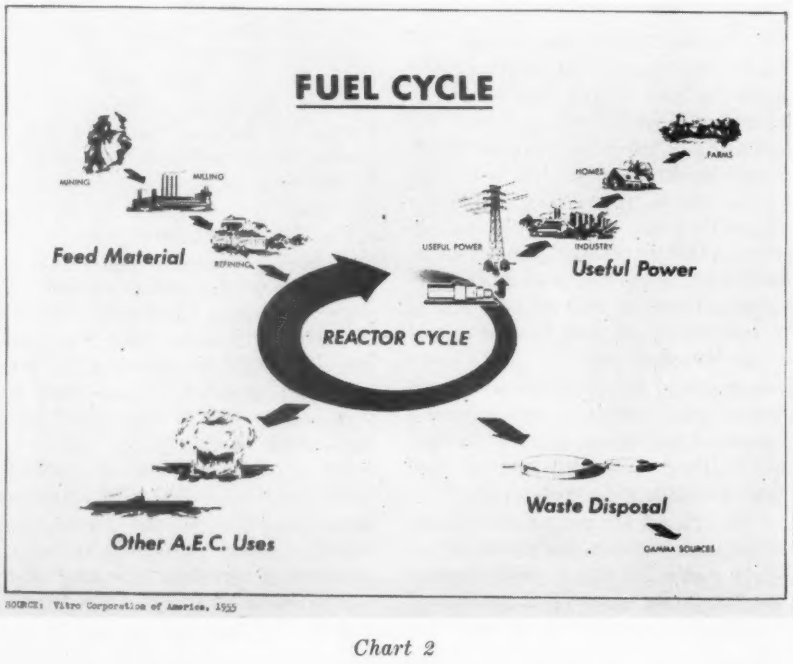
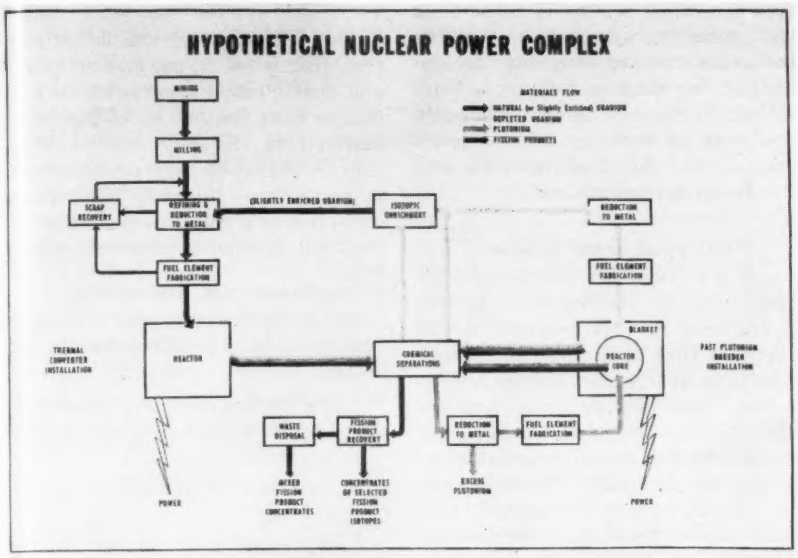


Chart 2



SOURCE: Vitro Corporation of America, 1955

Chart 3

The mining of uranium has become such a glamorous and well-known subject in the past two or three years that we shall not dwell on it here, except to show it as the necessary first step. Jesse C. Johnson, director of the AEC's Division of Raw Materials, recently stated that it is impossible to measure the dollar value of all the uranium prospecting and exploration activities, but that when it was added to the expenditures for production and construction, we have in the United States at least a $100 million a year uranium industry. To this would have to be added the values for the similar activities in foreign countries supplying the United States.

Mining

Uranium is found in this country chiefly on the Colorado Plateau, but now many other areas are being explored with good results, including Wyoming, South Dakota, California, Washington, Oregon, Idaho, Nevada, Arizona, and New Mexico, with smaller deposits being found even in the East. Originally uranium was obtained chiefly in pitchblende and carnotite deposits, but it is now being found in other formations. There are well over 100 different mineral forms for fission fuels, well over 200 geologic terms for them now in use.

In foreign countries outside of the USSR and satellites, the large major sources include the famous Shinkolobwe, or Mother Lode as it has been called, in the Belgian Congo. Next to that are the ore wastes of the gold mining industry in South Africa, and the Canadian deposits at Great Bear Lake, Great Slave Lake, and in the Blind River District. And now there are new fields beginning to produce in Australia and Portuguese Africa.

All these are known uranium-bearing areas minable under today's economics, so we don't have to worry about the failure of uranium to supply us with enough fuel for a while, even though the government's weapons requirements are such that today the AEC appears never to have enough uranium to meet all the military schedules.

Milling and Concentrating

Immediately after mining is milling, the major bottleneck at the present time. There are nine mills for processing uranium ore on the Colorado Plateau, and it has been announced that two more are to be constructed immediately. If the projects of the recent Atomic Industrial Forum survey are to be met by 1964 there would have to be ten to 15 new mills built in the United States. The capital investment required for this new milling capacity is rather sizable, being on the order of about $100 million.

There is one additional aid to the milling program, and that is the function of recovery of uranium from scrap metal and scrap materials of all sorts, or secondary recovery as it is called. In the metal industries it is said that about 40 per cent of the normal requirement comes from scrap recovery so that that is an important link in the fuel supply. Our Vitro Rare Metals Co. operates a scrap recovery operation at Canonsburg, Pa., used as a peak load facility by the AEC, and it has been said that such an operation gives the equivalent of another ore mill.

We shall not dwell on the processes of the mills, except to say that, while there are many different kinds of ores, typically, the ores are crushed and subjected to leaching, and some have to be roasted. After further treatment to remove impurities the precipitates yield high-grade concentrates of uranium oxide, generally known as U_3O_8. In many cases vanadium is also extracted as V_2O_5.

Raw Material Costs vs. Nuclear Reactor Costs

Two primary points should be kept in mind concerning the importance of raw material costs on nuclear reactor costs. The first is that the cost of the raw material is not particularly dependent upon a specific reactor fuel cycle—i.e., it takes just so much material to produce a given amount of heat, and thus power—and this amount of material will cost about the same for the several reactor cycles. It may be pointed out that raw material production capacity today is geared to the defense needs and that it will be years, if not decades, before nuclear power demands become the major factor in the production quotas. Recent estimates in the Atomic Industrial Forum survey indicate that the nuclear power industry may require 8000 tons per year within ten years. If in the event defense needs are reduced, and if the production of nuclear power raw material enters a truly free economy, the highly competitive stage would be reached wherein the processing of available ores reaches a price range determined only by the "free market" price, that is, cost plus overhead, plus profit margin. This, in effect, would provide a raw material dependent primarily on ore quality and transportation requirements. Most significant, however, raw material costs are a minor component of the fuel cycle cost, and are today far overshadowed in importance by reprocessing, fabrication, and waste disposal.

Feed Materials Preparation

Uranium in the form of ore or concentrates requires purification before it can be processed into metal. This purification can be accomplished by dissolving the material in acid, and then removing the uranium from the resultant solution by means of solvent extraction. The product for this purification operation is usually a concentrated aqueous solution of high purity uranyl nitrate. This high quality material may then, in turn, be processed to massive metal suitable for nuclear reactor fuel.

We shall not discuss the detailed steps of the various processes involved, but it is significant that this entire final stage of preparation of feed materials is not yet open to private enterprise. It is a government monopoly and operated by contractors in government plants for the AEC.

Fabrication of Fuel Elements, or Preparation of Fuel Solution

Now we come to fuel element fabrication and this concerns you, gentlemen of the power industry, very deeply. It is of concern to your engineers, because for the various types of power plants there are an amazing number of approaches to fuel element design. It may sound very gay to start out on a new and uncharted fuel element design. Your excitement will not have died away before you are confronted with the serious problem of how you are going to reprocess that element subsequently when it becomes used fuel in your furnace. You will find that if you sheath the fuel with zirconium or even aluminum, or in some cases with stainless steel, that you may have greatly complicated the fuel processing function and run up your costs.

One important thing which the reprocessing study at Vitro has made clear to us is that the engineers who are making power cost estimates and thus trying to evaluate the cost of atomic power have not as yet been too realistic in evaluating the cost of restoring the used fuel. Vitro has figures to show that the cost of treating these fuels and fuel elements can be as great as seven mills or more, and since we are often reading in the current literature that it is possible to produce and sell power for seven mills it appears that at least, in many of these cases, fuel reprocessing has been lost sight of.

It is quite obvious that you are behind the 8-ball if this is to be your fuel processing approach, so that the gentlemen who are designing fuel elements today may be doing it a little blithely without looking sufficiently into what we know as the real problems of cost for fuel recovery and thus for fuel reprocessing.

Operation in the Reactor

Our next step concerns the reactor itself. One of the important factors in the over-all fuel economy is the length of time that fuel can reliably operate in the reactor before reprocessing. This implies for a given design that the fuel element will meet and stand up under all reasonable operating requirements. The fuel cycle time is set by nuclear physics considerations as they affect the fuel element and its ability to stand up during that period. At the present time it is indicated that longer irradiation times are desired and can be tolerated, but that the limits are imposed by the present state of fuel element development.

As irradiation times are increased the number of end products and hence the radioactivity of the end products will vary. Thus, in general, there will be more radioactivity to deal with per unit of usable fuel reclaimed and which thus must be handled in the separation and waste disposal stages.

Reprocessing

The next step is the reprocessing, which involves both the decontamination of poisoned reactor fuel, and the metal recovery for return to fuel refabrication and for by-product plutonium. There is also the considerable problem of waste disposal. It is a highly complicated series of operations, costly and vital to reactor operation. Let us see why fuels must be processed and how the reprocessing is done.

Fission Products and Irradiation Damage

In a reactor the fission reaction produces by-products referred to as fission products. Some of these fission products tend to inhibit the chain reaction, which means they poison the reactor. Also there are physical deterioration and dimensional changes in the fuel element caused by the high localized energy release of the fission products in the fuel elements, and excess neutrons.

Burnup

The side effects of the fission reaction, that is fission product poisoning, and fuel element deterioration, combine to limit the amount of fissionable material in the fuel element which may be consumed before reprocessing is necessary. Normally the amount consumed is a very low percentage of the total fissionable material present.

Reasons for Reprocessing

Hence the periodic reprocessing of reactor fuels is required for the following reasons:

1. To prevent loss of radioactivity of the reactor due to fission product poisoning;
2. To repair or prevent irradiation damage;
3. To recover valuable fuel and fertile materials and perhaps by-product plutonium.

The frequency of reprocessing is dependent upon the type and design of the reactor and upon whether the reactor is operated to produce power or primarily for new fissionable material.

Vitro Reprocessing Study

Because we at Vitro believe in the vital importance of chemical processing to atomic power development and because we believe that additional emphases should be directed in this field, we have for a year been engaged in a processing study. This work, which is entirely company financed, is being carried out under an industrial participation contract with the AEC.

The broad purpose of our study is to look into the chemical and metallurgical reprocessing problems associated with different nuclear power systems. Our main objectives are as follows:

1. To analyze the likely opportunities for participation in commercial reprocessing activities.
2. To evaluate the processing requirements and techniques and determine the most promising avenues for research and engineering effort which can result in reduced reprocessing costs.

Another aim of the study has been to increase the awareness among the reactor designers and potential operators of the role that fuel reprocessing plays in the reactor complex. In the design of a fuel element one

important consideration should be the ease of reprocessing. It may not be the controlling factor in the selection of a design, but obviously the difference in costs of reprocessing should be balanced against other advantages or drawbacks of any proposed elements or systems.

The only actual operation of a reprocessing cycle is conducted today by the AEC itself. Vitro Corp. has an industrial participation contract to study this field because of its extensive experience in engineering and building three major separations facilities, chiefly for the plutonium extracting process, at Hanford, Wash. It has had its hands dirtied, so to speak, in the problem. This is my sole excuse for speaking with some feeling on the subject. We have actually contacted the problem. We know its nature, and we at Vitro are investing a large sum of our limited funds in its study. And yet, today, there are no customers, and there is no market.

Separations Processes

Chemical separations technology has been extended today to a number of other processes with success and also with recorded successful operational experience in government laboratories. This work is still being carried out on a very extensive scale and continuous technological improvements are being reported.

With respect to heterogeneous reactors using solid fuel elements, a considerable number of process methods have been proposed and investigated for performing the required separations. These methods may be broadly classified into two categories:

1. Aqueous methods including such techniques as precipitation, solvent extraction, ion exchange, and electro-chemistry.
2. Non-aqueous methods including volatilization techniques, electrochemical techniques, and high temperature metallurgical processes such as slagging and liquid metal or molten salt extraction.

The choice of a processing method for any specific reactor system involves a complex balance of both technical and economic factors. Of prime importance is the degree of separation and decontamination required by the fuel element refabrication plant; another major factor is the problem of waste disposal.

Problems of Reactor Processing

The problems of chemically processing irradiated material include all those normally associated with design, operation, and maintenance of conventional complex chemical plants, plus a group of unique problems which results from the unusual properties of the material being processed. The unique problems are the effect of toxicity, radioactivity, and critical mass. The conventional problems, magnified to a high degree, include requirements for a very high yield, extreme end-product purity, and for radioactive waste disposal.

We do not have the opportunity, here, to go into the problems of radioactivity or criticality. Nor can we go into the matter of degree of contamination, which is the problem of attaining a high degree of separation between materials present in unusually low concentration. Typical decontamination factors may be in the order of a million to one, and higher.

The decontamination problem is to start with what under normal situations might be considered a comparatively pure material, for instance, one which is contaminated only to the extent of a few parts per million, and reduce the contamination a millionfold. This extensive decontamination is necessary because even the slightest trace of impurities would result in a material so radioactive that it could not be handled by normal means.

There are lots of little booby traps in this business of refabrication of fuel elements. One is that the original fuel elements as they come out of the reactor are radioactively hot. In the main the engineers who have been working on setting up fuel elements for processing have been setting up cold fuel elements for the new reactor. Hence one of the important problems is to set up a facility which can not only separate these highly radioactive components, but can restore them to a form in which they can go back into the atomic reactors. An example on a very large scale of this type of facility is to be found in the remote control handling equipment for plutonium treatment at Hanford.

The matter of remote control of these radioactive fuel elements not only means that there can be no human being in direct or near contact, but that there must be a means of equipment maintenance, since the process is one of taking a sticky mess of uranium, in a kind of pulp, and converting it chemically into a stock of solid uranium for casting or forming the metal fuel element back into the shape of the original fuel element design.

It is quite a large problem!

Disposal of Waste Products and Fission Product Utilization

Waste Disposal

Waste disposal is another problem which, while it is common to both conventional and radioactive plants, is extremely difficult to solve in the latter case. Radioactivity cannot simply be destroyed nor can its rate of attenuation, or decay, be changed. Radioactive fission products decay at fixed rates known as half-lives, which vary from a few seconds to thousands of years. Therefore the problem resolves itself to one of either isolating and storing these wastes in as permanent a storage system as possible or to treating them so that they may be safely dispersed. If the radioactive wastes are of a sufficiently low activity level they can be dispersed, either by discharge through a stock or by discharge to a river, or other large body of live water, providing sufficient dilution can be obtained and maintained to reduce activity to below safe tolerance limits. High activity wastes, however, must be stored or isolated for such a period of time as is required. Such long term storage of material whose half life may run many years entails a continuing high operating expense to any plant handling such radioactive material.

Utilization of Fission Products

It is conceivable that future utilization in these wastes of fission product energy may to some degree offset this cost and a considerable amount of interest is being exhibited in potential applications for such energy in processes such as sterilization of food and drugs, the activation of certain chemical reactions, inspection of materials, etc.

The field of fission products is a very large one, and it may affect the economics of the production of nuclear power to an astonishing degree. Let's take one example, for instance, strontium-90, a wonderful fission by-product which can be a very useful and at the same time a very dangerous sort of thing. It has great radioactivity and a very long half-life. Such a long

life, that by the year 2000 you might have sufficient strontium-90 that if it were put into the oceans of the world it would make 5 per cent of them contaminated to a dangerous point.

Thus the dumping into the sea, because of the concentrations involved, would be an impossible way to solve the problems of disposal. If you can't dump this liquid-processed material into the sea, what can you do with it? If you choose to concentrate it, it is an expensive process and may cost you 0.4 mill per kwhr, and if you do process it with a 35 per cent efficiency, your concentrate then must be handled, and, of course, this means remotely handled, because it is highly radioactive. You may try to put it in a tank and put it under ground. The trouble is that if you make the tank of stainless steel and buoy it, the material might, in time, seep through and get into the ground water. It could then be a great menace and a great danger.

The problem as it appears to some people is of such a character that, with no market, they have seriously proposed putting these concentrates into an interplanetary missile and firing them into outer space. Another method of disposing of them which is being considered by the scientific fraternity is to use a nuclear transformation and convert strontium-90 into strontium-91 by neutron bombardment. It would be an expensive process indeed for that sole purpose. Strontium-91 has something on the order of a ten-hour life against 20 years for strontium-90 and it would cool off in a reasonable time so that it could be handled much more easily. Strontium-90 is cited merely to illustrate one of the more unrecognized problems.

Dr. Lawrence R. Hafstad pointed out that there is work being done to try to make it desirable to sell these fission products. One approach is for the treatment of foodstuffs. You have all, no doubt, seen pictures of potatoes which have been stored for a year and have grown no roots. These were treated mildly with certain radiation. This has also been done in pasteurizing milk and preserving meat, etc. The problem is not simple because if you thoroughly treat some food, like meats, you modify the flavor and since the public taste and, hence, appetite, is a fairly traditional sort of phenomenon, this makes the food unsalable in certain circumstances. Unless you can re-educate the public, this way to preserve food may be some time in coming. This problem is now a subject of much current research and study.

It has been pointed out that strontium-90 might be sold for 50 cents a curie—a curie being the amount of radiation emanating from a gram of radium. If you sold this product for 50 cents a curie, according to the Atomic Industrial Forum figures, you would have in the year 1964 an income of $60 million. You will notice that these are big figures. They are based, also, on crystal ball techniques, and our crystal balls are likely to be very cloudy. Such estimates are not to be regarded as facts, but are simply a means of pointing out some of the many unknown problems. If the power industry can sell the "fly ash" from its atomic furnaces at such prices, it will have automatically paid for the treatment of the separations of the fuel and will have made a big contribution toward reaching the economic paradise of the competitive cost of atomic fuels to present day fossil fuels.

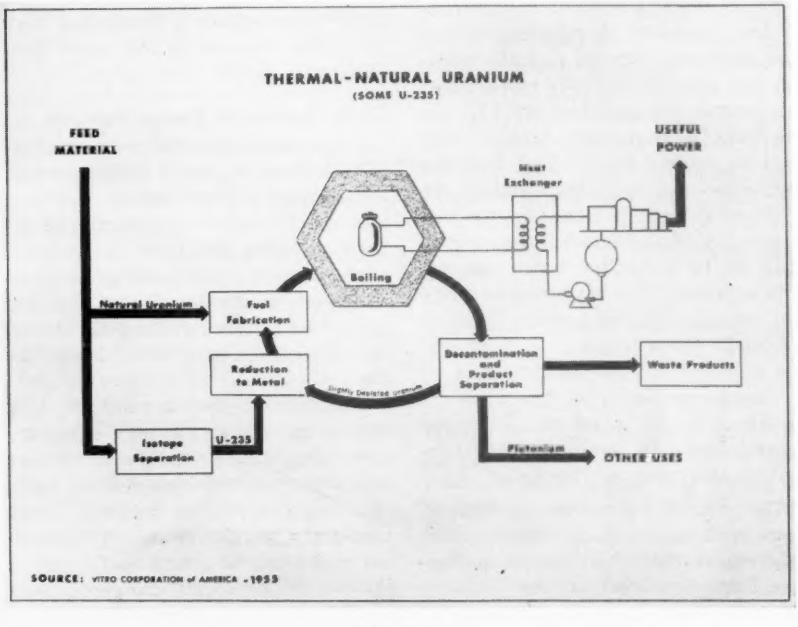


Chart 4

Typical Reactor Fuel Cycles

Let us now look at three typical fuel cycles to illustrate the importance of each of the steps we have mentioned, and to point out areas where continuing research, development, and operating experience should lead to significant improvements of power cost, as reflected by proven technology.

Thermal Reactor

This type, and all other types are to be regarded as generalized models, not necessarily corresponding to anyone's fixed design. This one is water-cooled and has moderated fixed fuel. It uses, largely, natural or depleted uranium supplemented by enriched uranium as required. (See Chart 4.)

For another typical reactor there is the heterogeneous or fixed-fuel type, which uses water as the moderator-coolant. For either a light water or heavy water machine, a substantial amount, if not all, of the fuel could be natural uranium, supplemented, when necessary, with small amounts of enriched uranium. The high temperatures and pressures that are attractive for power production will probably require high temperature special engineering materials. In addition, these fixed fuel elements will be rather precise in manufacturing techniques to meet the relatively stringent tolerances imposed. The use of the special engineering materials and the requirement of close tolerances certainly suggest a rather expensive product.

Fast Breeder Reactor

The fast breeder uses fixed fuel, is liquid metal cooled, and uses enriched

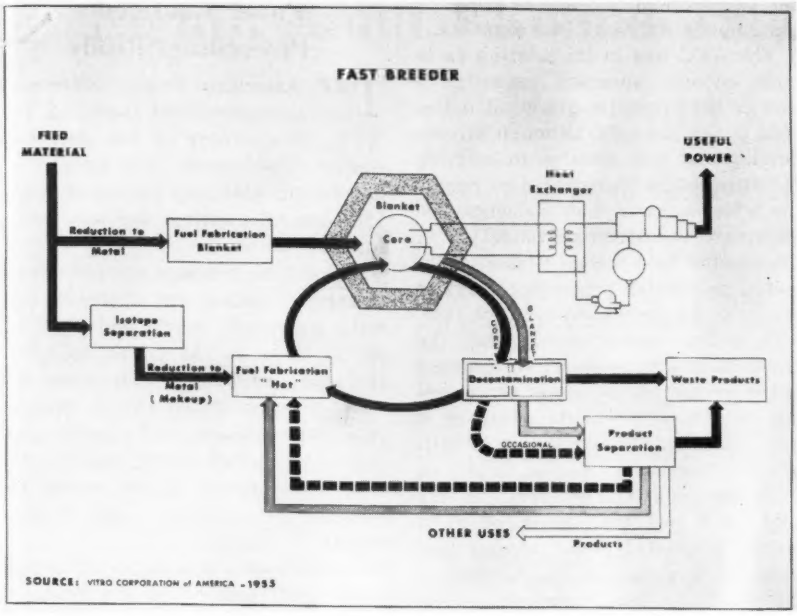


Chart 5

uranium, and probably plutonium alloy, fuel with a blanket for breeding also being provided. (See Chart 5.)

The larger critical mass in a fast breeder reactor and the shorter in-pile fuel cycles result in inherently large fissionable inventory requirements. Upon this must be imposed the "out-of-pile" inventory tied up in the reprocessing cycle. Economics dictate reduction of this out-of-pile inventory to a minimum by returning the bulk of the fuel metal as quickly as possible to the refabrication plant for reconstitution into fuel elements. Excess plutonium may be recovered as a by-product for sale.

Since the decontamination in a fast breeder is incomplete, and yet the activity is high, the entire plant must be operated remotely, including the refabrication and assembly of the fuel elements. This calls for ingenuity as well as more expensive maintenance requirements. To determine the overall economics of nuclear power, however, the fuel effect for minimizing the inventory charges must be carefully evaluated, together with other factors, such as credit for fuel produced by breeding.

Homogeneous Reactor

This selected type of homogeneous reactor is typical of the circulating liquid fuel type. It uses an enriched uranium core with a thorium blanket for uranium-237 production. (See Chart 6.)

The homogeneous reactor concept offers inherent advantages in reprocessing economics in that there is no solid metal handling or solid fuel element fabrication step. Besides eliminating the costs of these operations, the decontamination required may not be as rigorous as in other types of reactor reprocessing cycles. Of course, it follows that there is no radiation damage to the fuel structure since it becomes a circulating liquid. Thus, in this system, there is likewise no separation of fuel and breeder material, a minimum of decontamination and no refabrication step as such, all contributing to significant economics in the cost of reprocessing. However there are other problems peculiar to this type of reactor.

What of the Future?

It is just as difficult to tell what the future holds for us in the field of materials and fuels for atomic reactors as it is in any other industrial field of operation—perhaps more so. There are certain factors, however, which do seem evident to us, even in this early stage.

Uranium itself, for instance. Jesse Johnson recently said that it seemed reasonably probable that the market for uranium metal for the power industry might be about 14,000 tons a year by 1980, assuming that if costs can be brought near five mills per kwhr the industry should grow rapidly. Fourteen thousand tons of metal means 17,000 tons of uranium oxide, which, Mr. Johnson thinks, will certainly be available, at a selling price of probably not more than $10 per

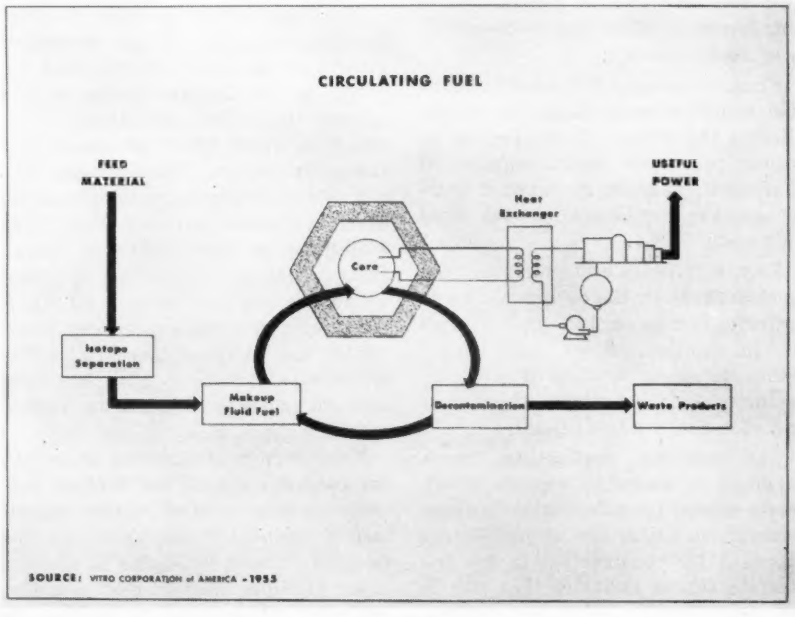


Chart 6

pound, in terms of today's dollars, for a high-grade concentrate.

In addition, by-product uranium production from the phosphate industry, which has already commenced, will grow in importance, and the cost of such uranium according to Mr. Johnson, may run from $30 to $50 per pound. By the time this material is needed burn-up efficiency and "breeding" may have improved the utilization of nuclear fuel so that ten tons of uranium, or even five, will be doing the work of 50 tons. And then too, thorium is expected to become an increasingly important nuclear fuel.

So far as processing is concerned, even at the preliminary step of investigation we find a number of significant factors which can be tabbed as having considerable effect upon the general economic outlook of the nuclear power program:

First, all the commercial reactors now being studied will require reprocessing facilities, operated either by government or private interests;

Second, within a competitive power economy there is a limit to the fuel processing cost which the operator of a power reactor can afford. The unit cost of fuel reprocessing is markedly affected by plant capacity, and is therefore dependent upon the number, size, and kind of fuel elements of the plants which it services;

Three, transportation of an irradiated fuel to a distant processing center has a significant bearing upon the unit fuel cost, which probably does not, however, offset the cost dependence upon capacity;

Four, processing different kinds of fuel elements in a single plant complicates the design of the facility in respect to process design, amount of equipment, and the operational techniques, greatly increasing the final unit cost;

Five, significant economic gains can be established by the determination of optimum factors such as mass criticality in solution, direct maintenance techniques, simplification of servicing facilities, and development of practical and economic waste disposal.

The economic desirability for a chemical reprocessing venture is directly related to optimization of these factors. An evaluation of the reactors proposed for construction in the immediate future indicates that this is not now being carried far enough. These planned reactors are widely spread geographically and all presently contemplate different fuel elements.

The AEC has in its existing facilities enough apparent capacity to service the presently conceived industrial power reactors, although process development and revision to existing facilities would be required to handle the wide range of fuel elements. To encourage industrial participation in the reactor field the AEC has volunteered to furnish processing services at a price set specifically for each case.

It is our understanding that the government has no desire to continue as the commercial source of reprocessing services and will do whatever it can, consistent with its responsibilities for the use of public funds, to encourage industrial enterprise in this field. We feel that their offer to service irradiated power reactor fuel elements is a special and temporary expedient and that it recognizes the limitations impeding the commercial entry in the field at this stage of development. And the time will also come, we are sure, if not already at hand, when the AEC's facilities for reprocessing would be overloaded.

We also have evidence that the reactor designers will in the future become more and more aware of reprocessing economics. This will mean that in core design they will keep in mind the need for decreasing reprocessing costs.

Forecast by the Atomic Industrial Forum

The most comprehensive forecast publicly available of the estimated growth of the atomic energy field for power is "A Growth Survey of the Atomic Industry, 1955-1956," published in April, 1955, by the Atomic Industrial Forum. That survey makes a number of very interesting calculations, and in summarizing them it has something to say about the "large central station," or power reactors, which are expected to pick up significant economic power demand about 1961-2 and increase thereafter. The minimum assumptions, however, show nominal economic demand until after 1964 for the U. S.

This survey states that currently the capital costs of the nuclear portions of large central station experimental units are estimated on the basis of current estimates to average about $127 per kilowatt-heat capacity, exclusive of fuel, and to decrease to about one-third of this by 1964.

Power Conference Proceedings Ready

THE American Power Conference has announced that copies of Vol. XVII, *Proceedings of the American Power Conference*, containing all papers and addresses presented at the 1955 annual meeting, are now ready for distribution.

The volume contains complete texts of some 85 papers and addresses covering practically every field of interest to those in the power industry. Included are papers containing the latest information on electric generation, transmission and distribution, fuels, water technology, central station steam power plants, water resources, gas turbines, and nuclear energy.

Included also is a series of papers devoted to research in the fields of steam generation, steam turbines, and fuels.

The volume is bound in cloth and contains approximately 800 pages with hundreds of illustrations, charts, and tables. Copies may be purchased by sending orders to R. A. Budenholzer, Director, American Power Conference, Illinois Institute of Technology, Technology Center, Chicago 16, Ill. The price of the volume is $6.00 per copy.

In calculating the make-up requirements for power reactors the survey assumes they will operate at an 80 per cent load factor, or 7,000 hours a year at maximum heat output. It has also been assumed, for the period prior to 1960, that the fissionable materials produced would be sold to the government and only small quantities used as fuel in the reactors. After 1960, it has been assumed that approximately one-half the fissionable materials produced will be fed back as fuel. In calculating the annual unit requirements for processing or recycle it has been assumed that before 1960 a power reactor will burn 0.3 per cent of the uranium fed into it before reloading, and that after 1960 the fuel burnup will be 0.7 per cent and that on the average the fuel charge in the reactor will have to be removed and treated twice per year.

Thus, in closing, it would seem that to return to our opening simile—this is quite a pile of by-product debris to sweep under the rug and expect it to stay hidden very long!

Eighth Annual Round Table Conference Program

By John C. Arnell

Director of Industrial Relations, Consolidated Edison Company of New York, Inc., and Chairman, EEI Industrial Relations Committee

"MAKING Personnel Administration Pay Off" is the theme of the three-day Eighth Annual Round Table Conference of the EEI Industrial Relations Committee to be held September 19-21, 1955, inclusive, at the Drake Hotel, Chicago, Ill.

The four topics which will highlight the Conference are: "Living Profitably Under the Union Contract," "Using Manpower Effectively," "Making Communications Pay Off," and "Making Employee Services Profitable." The program will include keynote talks and group discussions of these phases of personnel administration, with emphasis on the fact that the personnel function, like all managerial functions, must contribute to profitable corporate operation.

While attendance at the Conference is limited to members of management of the electric light and power industry, operations as well as industrial relations people are cordially invited. Past experience has shown that these conferences have been of great value to the participants and their companies in providing a broad familiarization with the attitudes of the industry as presented by "opposite numbers" from widely diverse sections of the nation.

The four primary topics for discussion at the Conference will be introduced by keynote speakers at a general session to be held on Monday, September 19. T. G. Ayers, Vice President, Commonwealth Edison Co., chairman of the subcommittee in charge of the Conference program, has announced the keynote speakers as: K. K. Allen, Manager of Industrial Relations, Southern California Edison Co.; C. Y. Osburn, Assistant Vice President, Long Island Lighting Co.; Dewitt Pike, Superintendent, Employee Relations Department, Rochester Gas and Electric Corp.; and H. Neely Henry, Executive Vice President, Alabama Power Co.

Presidents of three electric companies will address the Conference, during luncheon meetings, on each of the three days that it is in session. These men—Harllee Branch, Jr., President of the Edison Electric

Speakers and Conference Leaders

Luncheons

HARLLEE BRANCH, JR., President, Edison Electric Institute, Georgia Power Co.

JOHN W. EVERS, President, Commonwealth Edison Co.

N. BERNARD GUSSETT, President, Iowa Power and Light Co.

General Meeting

K. K. ALLEN, Manager of Industrial Relations, Southern California Edison Co.

H. NEELY HENRY, Executive Vice President, Alabama Power Co.

C. Y. OSBURN, Assistant Vice President, Long Island Lighting Co.

DEWITT PIKE, Superintendent, Employee Relations Department, Rochester Gas and Electric Corp.

Living Profitably Under the Union Contract

G. A. BEATTY, Personnel Director, The Ohio Power Co.

C. H. CAMPBELL, Personnel Director, Pacific Power and Light Co.

F. M. OSTA, Director of Employee Relations, Niagara Mohawk Power Corp.

H. A. PETERSON, Vice President, American Gas and Electric Service Corp.

J. A. TALLEY, Chairman, Labor Relations Committee, California Electric Power Co.

Using Manpower Effectively

H. F. CARR, Manager, Personnel Department, Pacific Gas and Electric Co.

C. R. DEWHURST, Superintendent of Industrial Relations, Public Service Electric and Gas Co.

G. W. HATHWAY, Administrative Vice President, Central Illinois Light Co.

G. E. MCKENNA, General Coordinator, Public Relations, Ohio Edison Co.

H. R. PEARSON, Manager of Operations, Iowa Power and Light Co.

Making Communications Pay Off

M. F. BUNNELL, Director of Personnel, Florida Power Corp.

A. L. COLLIGAN, Director, Personnel Administration, Central Hudson Gas and Electric Corp.

A. J. HASWELL, Director, Personnel Administration, Oklahoma Gas and Electric Co.

L. JONES, Director of Employee Relations, Union Electric Co. of Missouri

H. V. POTTS, Director of Employee Relations, Columbus and Southern Ohio Electric Co.

Making Employee Services Profitable

L. W. ESTEN, Vice President and Treasurer, Central Illinois Electric and Gas Co.

F. M. KEITH, Personnel Department Head, Dallas Power and Light Co.

W. K. PAUL, Manager of Industrial Relations, Northern Indiana Public Service Co.

E. C. STOLPER, Personnel Director, Wisconsin Power and Light Co.

J. S. WEEKS, Policy and Procedure Coordinator Consolidated Edison Co. of New York, Inc.

Institute and President of Georgia Power Co.; John W. Evers, President of Commonwealth Edison Co.; and N. Bernard Gussett, President of Iowa Power and Light Co.—will present an evaluation of industrial relations through their individual speeches concerning manpower, economics, and philosophy policies.

Mr. Branch, who will speak on the opening day (Monday), will discuss manpower, with particular emphasis on the development of efficient management personnel both as individuals and as members of the team. He will point up the challenging problem facing the industry of so developing management that the efficiency of its performance will match the efficiency now being achieved by our most up-to-date equipment.

The Tuesday luncheon meeting will hear Mr. Gussett speak on the economic consequences of the decisions and actions of all employees, with particular emphasis on supervisors. Mr. Gussett will emphasize the necessity of thinking through a proposed course of action in order to visualize its economic results.

Mr. Evers will address the final luncheon meeting on Wednesday. His speech will develop a theme of the importance of sound industrial relations philosophy to a utility company's success and reputation in the communities in which it operates. In his speech, Mr. Evers will draw upon a lifetime of utility company operation to illustrate how a company's human relations affect all other aspects of the business.

"How To Do It" Sessions

During sessions on Monday afternoon, Tuesday morning and afternoon, and Wednesday morning, conference delegates will divide into small "How To Do It" groups of no more than 25 persons to discuss the four phases of personnel administration under the direction of conference leaders of recognized ability. Registrants will be assigned to conference groups in advance, to provide the widest possible regional representation. Groups will be kept together throughout the round table discussions, thereby assuring each individual an opportunity to participate. In these sessions, the four main topics will be scheduled concurrently.

Conference leaders, listed by topic, will include:

"Living Profitably Under the Union Contract"—G. A. Beatty, Personnel Director, The Ohio Power Co.; C. H. Campbell, Personnel Director, Pacific Power & Light Co.; F. M. Osta, Director of Employee Relations, Niagara Mohawk Power Corp.; H. A. Peterson, Vice President, American Gas and Electric Service Corp.; and J. A. Talley, Chairman, Labor Relations Committee, California Electric Power Co.

"Using Manpower Effectively"—H. F. Carr, Manager, Personnel Department, Pacific Gas and Electric Co.; C. R. Dewhurst, Superintendent of Industrial Relations, Public Service Electric and Gas Co.; G. W. Hathway, Administrative Vice President, Central Illinois Light Co.; G. E. McKenna, General Coordinator, Personnel Relations, Ohio Edison Co.; and H. R. Pearson, Manager of Operations, Iowa Power and Light Co.

"Making Communications Pay Off"—M. F. Bunnell, Director of Personnel, Florida Power Corp.; A. L. Colligan, Director, Personnel Administration, Central Hudson Gas & Electric Corp.; A. J. Haswell, Director, Personnel Administration, Oklahoma Gas and Electric Co.; W. L. Jones, Director of Employee Relations, Union Electric Co. of Missouri; and H. V. Potts, Director of Employee Relations, Columbus and Southern Ohio Electric Co.

"Making Employee Services Profitable"—L. W. Esten, Vice President and Treasurer, Central Illinois Electric and Gas Co.; F. M. Keith, Personnel Department Head, Dallas Power & Light Co.; W. K. Paul, Manager of Industrial Relations, Northern Indiana Public Service Co.; E. C. Stolper, Personnel Director, Wisconsin Power and Light Co.; and J. S. Weeks, Policy and Procedure Coordinator, Consolidated Edison Co. of New York, Inc.

An opportunity to renew old acquaintances and make new friends will be afforded at the traditional Monday evening Hospitality Hour. This social event has a real value in enabling conference delegates to meet on an informal basis, thereby promoting a first name acquaintanceship among industrial relations men throughout the industry. The exchange of ideas and information among that group will be facilitated by this personal contact.

Another such opportunity for informal meeting will be at breakfast each morning when a number of tables in one section of the Oak Room of the Drake will be set aside for those attending the Conference.

The success of the role-playing demonstration, introduced last year as an innovation in the Conference, has urged a second performance of this technique. This year, the "New England Players" will act out the handling of a grievance. Entitled "An Arbitration," the presentation concerns the demotion of an employee and is based on an actual case. The salient points of the case will be presented by the players, then the audience will have a chance to determine what the decision should be. After the audience's decision has been made, booklets containing the arbitrator's decision will be presented to the audience. The role-playing demonstration will take place on Tuesday evening.

Another "repeat" phase of the Conference, also presented for the first time last year, is the Printed Materials Exhibit which will be open throughout the Conference. This year the exhibit will feature company booklets in the four most popular areas as indicated by the returns of a questionnaire. These areas are: Personnel Appraisal, Employee Manuals, Supervisory Newsletters, and Selling Fringe Benefits.

Program Subcommittee

Members of the subcommittee who have worked with Mr. Ayers to plan the program for the 1955 Round Table Conference are: K. K. Allen, C. H. Campbell, J. W. Carothers, J. S. Gracy, W. H. Senyard, and D. A. Bartlett, ex-officio.

Registrations, which will be accepted in the order of their receipt, should be made as soon as possible. Attendance will be limited to approximately 250. Both operations and industrial relations people are cordially invited to attend.

The registration fee of $35 includes luncheons, Hospitality Hour, participation in all meetings, and a special notebook. Registrations should be sent to E. S. Evans, Industrial Relations Committee, Edison Electric Institute, 420 Lexington Avenue, New York 17, N. Y.

Fatal Accidents in the Electric Light and Power Industry

By S. H. Young
The Hartford Electric Light Company

THE fatal accident experience of employees in the electric light and power industry in 1954 as reported to the Edison Electric Institute closely follows the pattern of previous years. The most outstanding deviation from past experience was in the percentage of electric shock and burn accidents which in the past has consistently accounted for 70 per cent of the total. In fact, the average for the past 14 years is 70.5 per cent. In 1954 the percentage of electric shock and burn fatalities dropped to an all-time low of 62.5 per cent.

14-Year Tabulation

There were 120 fatal cases reported in 1954: 75 of these were the result of electric shock or burn; 17 were due to falls; 14 were sustained in motor vehicle accidents; six were "struck by" accidents; two were "caught in" accidents, and six were miscellaneous. Summary 1 is a 14-year tabulation of this breakdown.

As usual the greatest percentage of electric shock and burn cases occurred on poles while doing line work without the man's "cutting out," slipping, or losing his balance. There were 43 such cases. In 25 of these, contact was made on the hand indicating that rubber gloves were not being worn.

Summary 2 is a tabulation of the types of electric shock and burn fatalities covering the eight years 1947 through 1954.

Effect of Hot Weather

Summary 3 is a tabulation of the 1954 electric shock and burn fatalities by months and definitely shows the effect of hot weather on the number of fatalities in our line crews. Forty of the 58 cases occurring "in the field" were during the months of May through September while those occurring "at stations" were more evenly distributed over the whole year.

Summary 4 which shows the ages of the men involved may not have any great value from a statistical or accident prevention standpoint but does give some idea of the number of productive years of manpower lost as a result of these accidents. One hundred twenty men prematurely retired at an average age of 37 years instead of the customary retirement age of 65 years.

Voltages Involved

Summary 5 gives the voltage of the circuits or apparatus involved. You will note that seven of the 75 cases or almost 10 per cent were in the secondary voltage class. This is proof enough that low voltage contact can be fatal and should be guarded against.

Summary 6 lists the types of circuits on which these accidents took place.

Extra Hazardous Conditions

While compiling these summaries, one thing of particular importance was noted. During 1954 there were an abnormal number of severe storms throughout the country. The Eastern seaboard had three severe hurricanes and other sections of the country had numerous tornadoes and wind storms.

Summary 1

FOURTEEN YEARS OF FATAL ACCIDENTS IN THE ELECTRIC LIGHT AND POWER INDUSTRY, 1941 to 1954 INCLUSIVE

(From EEI Accident Prevention Committee Summaries)

Year	Total	Electric Shock or Burn	Falls	Motor Vehicles	Struck By	Burned	Caught In	Drowned	Miscellaneous	No Data
1941	121	90	11	8	4	2	3	1	2	
1942	121	81	19	11	6	3	0	0	1	
1943	117	81	14	3	7	5	1	3	3	
1944	82	62	6	5	6	1	2	0	0	
1945	116	79	14	6	5	4	3	3	2	
1946	105	68	19	8	5	0	2	2	1	
1947	173	125	20	8	13	3	2	1	1	
1948	149	102	21	13	6	2	2	0	3	
1949	176	134	16	13	6	1	5	1	0	
1950	141	102	13	9	4	4	0	5	4	
1951	165	121	21	8	4	4	1	5	1	
1952	129	90	7	17	4	0	1	1	5	4
1953	134	93	18	12	6	1	0	0	4	0
1954	120	75	17	14	6	0	2	0	6	0
Total	1,849	1,303	216	135	82	30	24	22	33	4

DISTRIBUTION OF ACCIDENT TYPES

(By Percentages of Total Accidents)

	1954	14-Year Average	14-Year Range Minimum	14-Year Range Maximum
Electric Shock or Burn	62.5	70.5	62.5	76.0
Falls	14.2	11.7	5.4	18.1
Motor Vehicles	11.7	7.3	2.6	13.2
Struck By	5.0	4.4	3.1	7.5
Burned	0.0	1.6	0.0	4.3
Caught In	1.6	1.3	0.0	2.8
Drowned	0.0	1.2	0.0	3.5
Miscellaneous	5.0	1.8	0.0	5.0
No Data	0.0	0.2	0.0	3.1

Summary 2

ELECTRIC SHOCK AND BURN FATALITIES, EIGHT YEARS, 1947-1954

	1947	1948	1949	1950	1951	1952	1953	1954	Total
Line Work on Poles: Contacts Made While Climbing or in Working Position but Without Cutting Out or Losing Balance:									
Hands	32	24	28	25	26	26	14	25	200
Arms	10	19	21	14	19	11	11	6	111
Head	8	10	7	7	1	7	7	5	52
Neck	0	0	0	0	1	0	2	2	5
Body	7	7	12	5	4	1	7	4	47
Shoulder	0	0	0	0	4	3	4	0	11
Leg or Foot	3	1	3	3	1	1	3	1	16
Contact Not Given	2	3	6	2	5	2	0	0	20
Flash	1	0	0	0	2	1	3	3	10
Gaff Cutouts	6	2	6	3	5	4	2	0	28
Slips	3	3	2	0	0	0	2	1	11
Line Work from Ladders	4	0	0	1	1	0	0	0	6
Line Work in Trees	2	0	0	0	0	0	2	1	5
Line Work on Ground	13	13	15	9	9	10	9	6	84
Surveying	0	0	0	0	0	2	0	0	2
Street Light Replacement	0	0	0	0	0	0	0	2	2
Energized Cranes	0	0	0	0	3	1	2	0	6
Cablework Underground	2	2	2	2	0	2	0	1	11
In Basements	0	1	0	0	2	0	2	1	6
Total of Above	93	85	102	71	83	71	70	58	633
At Stations	32	17	32	31	38	19	23	17	209
Total	125	102	134	102	121	90	93	75	842

Summary 3

TABULATION OF FATAL ELECTRIC SHOCK AND BURN ACCIDENTS BY MONTHS

Month	Number of Cases in 1954 In the Field	At Stations	Total	14-Year Average
January	1	2	3	3.9
February	1	2	3	4.2
March	2	1	3	4.5
April	4	1	5	7.3
May	10	1	11	9.4
June	9	1	10	12.8
July	8	2	10	14.6
August	8	0	8	11.0
September	5	5	10	9.0
October	7	1	8	7.9
November	2	0	2	4.8
December	1	1	2	3.8
Total	58	17	75	93.2

Summary 4

AVERAGE AGES

	Years 1954	1953	1952
Average Age of Cases 1-58 (Linework)	33.5	33.6	34.1
Average Age of Cases 59-75 (Stations)	35.1	39.0	41.1
Average Age of Cases 76-120 (Non-electrical)	42.1	39.2	—
Average Age of Cases 1-120 (All Cases)	36.9	36.3	38.3
Average Age of Cases 93-102 (Motor Vehicle)	40.1	46.4	45.7

Many of the individual accident reports from which these summaries were compiled state that the work being done was repair work or during restoration of service following storms. We should be concerned over this because it has generally been the opinion that men are more careful, take more precautions, and at least wear their rubber gloves while on emergency work. But, there were 25 hand contacts on line work which may be an indication that they did not take the precautions necessary to overcome the extra hazardous conditions always present during emergencies.

Application of Equipment Handbook Revised

APPLICATION of Electrical Equipment in Commercial Establishments, a handbook for commercial sales representatives prepared by the Commercial Department of the Institute, is being revised and will be available in September. The handbook was originally published in 1952.

Two new sections, Miscellaneous Electric Heating Applications and Commercial Refrigeration, have been added to the contents which will fit any standard 6¾ by 3¾-in. ring binder. Intended to serve as a handy reference for the commercial sales representative, the handbook's basic information is designed to help the salesman make "on-the-spot" recommendations and estimates in preliminary form.

Prices for the publication may be obtained from the Commercial Department, Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y.

Summary 5

PHASE VOLTAGE OF CIRCUITS OR APPARATUS INVOLVED

	Number of Cases 1954	1953
Secondary Voltage Class	7	5
Up to 2400 Volts (Primary)	8	6
2400 to 4800 Volts	23	29
4800 to 7200 Volts	4	3
7200 to 13.2 kv	22	30
15 to 115 kv	9	16
Induced Voltage	1	2
Series Street Light Circuit	1	2
Total	75	93

Summary 6

TYPES OF CIRCUITS INVOLVED

	Number of Cases 1954	1953
Ungrounded Delta	16	18
Grounded and/or Common Neutral	32	46
Grounded Wye	6	9
Ungrounded Wye	2	0
Star System Grounded	1	2
Delta—1φ Wire Grounded	1	1
Series Street Light Circuit	1	2
Induced Voltage	1	2
Secondary Voltage	6	5
Not Given	9	8
Total	75	93

Review and Classification of 120 Fatal Accidents Reported During 1954 Within the Electric Light and Power Industry

Edison Electric Institute Accident Prevention Committee

(This summary was compiled from detailed reports submitted to the Institute)

			PATH OF CURRENT THROUGH VICTIM: Entry	PATH OF CURRENT THROUGH VICTIM: Exit	EQUIPMENT: Energized	EQUIPMENT: Ground	Voltage	Occupation	DESCRIPTION
LINE WORK ON POLES 47 CASES	CONTACTS ESTABLISHED WHILE CLIMBING OR WORKING IN WORKING POSITION BUT WITHOUT CUTTING OUT OR LOSING BALANCE	HANDS 25 CASES	Unknown	Unknown	Sec. Service	Unknown	120	App. Lineman	1. Transferring service wires on roof. Working barehanded; collapsed.
			R-Hand	--	Sec. Wire	Sec. Wire	120-240	Lineman	2. Extending secondaries. Placed hand between two wires.
			L-Hand	R-Wrist	Sec. Wire	Grd. Wire	120-240	Lineman	3. Removing line hose from sec. wire while wearing defective leather gloves. Made contact.
			R-Hand	Unknown	Sec. Wire	Unknown	208	Lineman	4. Relocating line; power leg left hot. Made contact and fell to ground.
			L-Hand	R-Hand	Pri. Wire	Pri. Wire	2300	Lineman	5. Repairing storm damage. Took hold of primary wire to make splice.
			L-Hand	L-Knee	X-Arm Brace	Tel. Cable	2300-4000	Lineman	6. Restoring service after storm. While belting in contacted X-arm brace hot from primary.
			R-Hand	L-Thigh	Pri. Jumper	Common Neut.	2300-4000	Lineman	7. Dropped down pole & removed rubber gloves to cool off. Grasped jumper in spite of warning.
			R-Hand	R-Leg	St. Lt. Wire	Sec. Neut.	2300-4000	Lineman	8. Repairing storm damage; assumed wires were dead; st.lt. wire crossed with primary one mile away.
			L-Hand	R-Hip	Pri. Wire	Pri. Wire	2300-4000	Lineman	9. Climbed up between primary wires before covering up.
			L-Thumb	L-Side	Pri. Tap	Grd. Neut.	2400-4000	Lineman	10. Work on pole completed; rubber covering & gloves removed; reached to remove hand line sheave.
			L-Hand	R-Leg	Pri. Wire	Sec. Neut.	2300-4160	Lineman	11. Closing jumpers on new circuit. Reached over and put hand on newly energized circuit.
			Hand	Feet	Pri. Wire	Pole	2400-4160	Lineman	12. Extending primaries. Failed to wear rubber gloves.
			R-Hand	L-Leg	Pri. Wire	Pri. Wire	2760-4800	Lineman	13. Climbed into primary area wearing leather gloves to throw handline thru trees. Made contact.
			R-Hand	L-Hand	Pri. Wire	Timeclock	-4800	Patrolman	14. Changing timeclock switch on pole; removed gloves to apply tape. Made contact.
			R-Hand	L-Hand	Pri. Wire	Neut. Wire	-4800	Lineman	15. Dropping services to ground & removing jumpers; primary wires not covered. Made contact.
			R-Hand	R-Foot	Pri. Tap	Gr. Wire	-7200	App. Lineman	16. Removed rubber gloves after replacing cutout; did not put gloves on to reconnect.
			Hands	R-Leg	Neutral	Sec. Wire	7200-12500	Groundman	17. Untying neut. barehanded when it was cut on line side; neut. energized by backfeed from trans.
			R-Hand	R-Foot	Pri. Tap	Common Neut.	7200	Lineman	18. Opened primary tap to install cutout. Contacted tap wire alive by backfeed.
			R-Hand	L-Hip	Pri. Cutout	Sec. Wire	6900-12000	Lineman	19. Replacing defective trans. Moved up between cutout and sec. rack to disconnect tap from line.
			R-Hand	R-Foot	St. Lt. Wire	Pole	-12000	Lineman	20. Repairing storm damage. Street light and 12,000V line crossed several blocks away.
			L-Hand	L-Foot	Pri. Wire	Trans. Case	7200-12470	Lineman	21. Changing transformer. Made contact.
			L-Hand	R-Side	Pri. Wire	Gr. Wire	7200-12470	App. Lineman	22. Wrong set of disconnects opened to de-energize line; no tests made; no grounds installed.
			L-Hand	R-Foot	Pri. Wire	Trans. Case	7200-12500	Lineman	23. Cut abandoned primary wire; victim pulled into adjacent live primary wire by strain.
			R-Hand	R-Leg	Pri. Wire	Neut. Wire	7620-13200	Lineman	24. Climbed pole and attempted to untie phase wire before it was de-energized.
			Hands	Legs	Grd. Clamp	Steel Tower	Induced Volt.	Lineman	25. Completed work on line; removed ground connection from tower before removing end from line.
		ARMS 6 CASES	Arm	Arm	Sec. Wire	Sec. Wire	120-240	Lineman	26. Feeding rope thru secondary rack contacted bare secondary conductor.
			R-Arm	R-Thigh	Pri. Jumper	Trans. Case	-2300	Subforeman	27. Had installed rubber goods; in throwing sling over X-arm contacted uncovered jumper above glove.
			Arm	Legs	Pri. Tap	Trans. Case	-2300	Lineman	28. Checking for loose connections on transformer. Not wearing rubber gloves.
			R-Arm	R-Side	Pri. Wire	Pri. Wire	2300-4000	App. Lineman	29. Kneeling on double arm; reached over uncovered primary to remove X-arm bolt; made contact.
			R-Arm	L-Foot	Pri. Tap	Gr. Wire	4100-7200	Lineman	30. Repairing lines after storm; reached for service tap; contacted riser tap above rubber gloves.
			R-Arm	L-Foot	Trans. Tap	Gr. Wire	-7200	Lineman	31. Inspecting fuses. Contacted transformer leg. Fell 20' to ground.
		HEAD 5 CASES	Back of Head	Chest	Sec. Wire	Sec. Neut.	120-240	Line Foreman	32. Transfering sec. to new pole; made head contact on live sec. while chest rested on neutral.
			Side of Head	L-Hip	Pri. Wire	Guy Wire	-2300	App. Lineman	33. Made contact while passing thru live primary on second arm to work on dead primary above.
			Side of Head	R-Leg	Pri. Wire	Sec. Neut.	2400-4160	Lineman	34. Pulling slack in sec. Climbed too high and contacted primary. No rubber goods in place.
			Forehead	Legs	Lt.Arr.Bracket	Sec. Wire	-4800	Serviceman	35. Replacing broken primary pin; fuses pulled. Reason circuit alive not determined.
			Side of Face	L-Thigh	Fuse Link	Sec. Lead	7200-12000	Serviceman	36. Clearing storm damage; trans. fuse link hanging down from cutout. Wind blew link against face.
		BODY 4 CASES	Chest	Feet	X-Arm Brace	Pole	-2300	Lineman	37. Installed X-arm. Arm tilted allowing brace to contact energized wire.
			L-Side	--	Pri. Wire	--	2400-4160	Lineman	38. Transferring primary to new pole. Rubber goods not properly placed.
			Chest	--	Tie Wire	Sec. Serv.	-4600	Lineman	39. Tieing in primary; line hose on secondary had moved. Tie wire contacted primary and chest.
			R-Side	R-Foot	Pri. Jumper	Common Neut.	7620-13800	Lineman	40. Passing jumper to man above. One end of jumper contacted primary wire; other touched body.
		NECK 2 CASES	Throat	R-Thigh	Pri. Wire	Common Neut.	2300-4000	Lineman	41. Clearing trouble; had pulled pri. up with block and falls. End of wire flipped over when cut.
			Back of Neck	Foot	Pri. Wire	Trans. Hanger	2400-4160	Lineman	42. Replacing temp. wires; victim bent down to release handline; made contact upon straightening up.
		LEG	R-Leg	L-Hand	Trans. Bushing	Trans. Case	7620-13200	Lineman	43. Reversing trans. secondary leads. Contacted trans. primary bushing alive from backfeed.
		LOST BAL.	R-Hand	L-Thigh	Pri. Wire	--	7200-12000	Lineman	44. Climbed out on double X-arm on hands and knees before given clearance; slipped and made contact.
	No Contact -- Flash Burns 3 Cases						6900	Serviceman	45. Restoring service after storm; closed defective recloser with switch stick. Tank exploded.
							-24000	Const. Mech.	46. Climbing over X-arm; air break switch arced over. Clothing caught on fire; fell to ground.
							69000-138000	Line Foreman	47. Installing armor on conductor with hot stick; armor in contact with wire flashed over.
75 CASES 62.5%	LINE WORK ON GROUND 6 CASES	Energized Wire	R-Hand	Feet	New Wire	Earth	1300-2300	Groundman	48. Attempting to free wire snagged on brush. Wire made contact with live primary above.
		Energized Boom	Hands	Feet & Hip	Winch Cable	Earth	2300-4000	Helper	49. Moving truck into position to set pole. Picked up winch cable as derrick contacted conductor.
		Down Wire	Body	Body	Down Pri.	Earth	2300-4000	Lineman	50. Restoring service after storm. Walked into down primary wire hidden in brush.
		Energ. Truck	L-Arm	R-Foot	Shovel	Earth	2400-4160	Helper	51. Pulling wire with power reel on truck; truck became energized; made contact with shovel on truck.
		Metallic Tape	L-Hand	Back	Metallic Tape	Tree & Earth	-7200	Foreman	52. Measuring for guy; metallic linen tape blew out onto primary wires beyond line hose.
		Fuse Switch	L-Hand	Feet	Fuse Switch	Earth	7620-13200	Serviceman	53. Clearing up pole broken down by car; job being worked hot; reached up & touched live fuse switch.
	TREE TRIMMING		R-Shoulder	Back	Pri. Wire	Tree Limb	-2300	App. Lineman	54. Trimming from wood platform on truck boom; contacted primary and brace in contact with tree.
	STREET LIGHT REPLACEMENT		--	--	--	--	St.Lt.Cir.	Patrolman	55. Replacing street light from ladder without rubber gloves; received shock. Fell to ground.
	STREET LIGHT REPLACEMENT		Shoulder	Body	Pri. Wire	Sec. Wire	-2300	Helper	56. Replacing st.lt. globes from hydraulic tower truck; cage traveled past st.lt. & into pri. wires.
	UNDERGROUND		No Contact -- Flash Burns				6350-11000	Helper	57. Removing abandoned cable; made hacksaw cut into wrong cable. Cable improperly numbered.
	REPLACING FUSE		No Contact -- Flash Burns				2200-4160	Troubleman	58. Closed oil fuse cutout in which fuse had blown. Explosion followed.

Review and Classification of 120 Fatal Accidents Reported During 1954
Within the Electric Light and Power Industry
Edison Electric Institute Accident Prevention Committee

(Continued)

			PATH OF CURRENT						
			VICTIM		EQUIPMENT				
			Entry	Exit	Energized	Ground	Voltage	Occupation	DESCRIPTION
ELECTRIC SHOCK OR BURN CONT.	AT STATIONS	ENERGIZED PTS	L-Foot	R-Knee-L-Hand	Bus	Grd. Bus	-4160	Meterman	59. Had removed CTs from dead 34.5KV bus; contacted 4160V bus still in service.
	ON OR AROUND EQUIPMENT	LINES, RISERS	L-Shoulder	R-Foot	OCB Lead	Steel Struct.	2400-4160	Electrician	60. Station re-energized after completing work; re-entered restricted area to wipe up oil spot.
		LEADS	Head	L-Hand & Thigh	Pri. Wire	Grd. Wire	7200	Lineman	61. Tightening hardware on sub-station structure; made head contact while belting in.
			Head	L-Leg	Jumper	Grd. Wire	7200-12470	Serviceman	62. Servicing street light circuit at regulator station; contacted test jumper.
			Hands	R-Side	OCB Cap	OCB Frame	7200-12500	Truck Driver	63. Inspecting & filtering oil on de-energized OCB; moved ladder to adjacent OCB & made contact.
		7	L-Hand	R-Hand	OCB Riser	OCB Riser	8000-13800	Sub.Sta.Oper.	64. Making visual inspection of struct. above OCB from ladder; lost balance, fell and made contact.
			Hand	Stomach	OCB Lead	Metal Cabinet	-33000	Meterman	65. Servicing OCB; returned from lunch and continued work before disconnects were re-opened.
	BUS STRUCTURES ETC.	CASES	L-Hand	Feet	Conductor	Steel Struct.	-34500	Elect. Mech.	66. Completed routine maint. of switch; after line was re-energized victim climbed struct. for tool.
		DISCONNECT SWITCHES	Nose	L-Shoulder	Disc. Switch	Steel Struct.	6900-12000	Maint. Man	67. Station out of service to replace CT; victim stood up on top of ladder & contacted disc. above.
			Face	Legs	Air Br. Sw.	Sw. Frame	-34500	Lineman	68. One side of air break switch alive; attempted to cross to other side of structure.
		3 CASES	L-Hand	R-Elbow	Disc. Switch	Steel Struct.	20000-34500	Electrician	69. Measuring for connection to transfer bus with folding rule. Made hand contact.
		FAULT CURRENT	R-Hip	Feet	Sw. Handle	Earth	12700-22000	Lineman	70. KFF switch arced over to steel structure when opened to separate two paralleled stations.
		MISCELLANEOUS EQUIPMENT	L-Armpit	Body	Light Cord	Ash Pit Door	110	Fireman	71. Contacted bare ext. cord which had pulled out of socket when passing thru boiler ash pit door.
			R-Hand	L-Knee	Carrier Trap	Trap Pedestal	24000-41600	Repairman	72. Taking name plate data off carrier trap in sub-station; climbed too high; made contact.
		3 CASES	Hand	Feet	Capacitor	Capacitor Mount	34000-69000	Electrician	73. Section of sub-sta. de-energized. Victim climbed into live section to paint capacitor cap.
		FLASH BURNS	OCB EXPLODED - NO CONTACT				-13000	Electrician	74. OCB on idle gen. exploded when jacked closed to check target; control fuses open; disc. closed.
		2 CASES	OCB EXPLODED - NO CONTACT				-13000	Elect. Helper	75. Same as 74.
FALLS 17 CASES 14.2%	LINE WORK 13 CASES	FALL FROM POLE OR TOWER 6 CASES			Hand Slipped From Pole			Patrolman	76. Flashlight held between neck and shoulder slipped; fell from pole when he grabbed for light.
					Lost Hold On Pole			Lineman	77. Climbing onto X-arm to remove temporary ground sticks; lost hold and fell to ground.
					Slipped From Pole			Lineman	78. Standing on reverse arm operating armor rod wrench; slipped and fell. Not belted in.
					Reason For Fall Unknown			Lineman	79. Working on tower; fell from hook ladder while belting in. Fell 45' to ground.
					Knocked Off When Rope Broke			Lineman	80. Replacing insulators on tower; knocked off arm when rope holding conductor broke; not belted in.
					Collapsed And Fell Down Pole			Lineman	81. Framing poles at sub-station; climbed pole; belted in; collapsed and slid down pole.
		FALL WITH POLE 4 CASES			Pole Broke Off At Ground			Cable Splicer	82. Removing X-arm from pole. Pole broke off below ground line.
					Pole Broke Off At Ground			Jr. Lineman	83. Abandoning old pole line; as last wire was untied pole broke off at grd. line & fell toward guy.
					Pole Broke Off At Ground			Serviceman	84. Truck had broken pole; victim climbed adj. pole and cut wires clear. Pole broke off and fell.
					Pole Broke Off At Ground			App. Lineman	85. Wires cut over to new pole held by "A" frame; old pole crowded over by new pole.
		FALL FROM TREE			Climber Cut Out			Troubleman	86. Climbed tree to install line hose to temporarily insulate wire from limb; cut out and fell.
		FALL FROM STEPLADDER			Reason Not Determined			Repairman	87. Cleaning street lamps on bridge; victim on safety ladder. Found unconscious on walk.
		FALL TO GROUND			Thrown By Wire			Groundman	88. Caught in knot in rope when rope holding strain in wire broke; victim thrown 35'.
	MISC. 4 CASES	FALL FROM STEPLADDER			Physical Condition			Warehouseman	89. Repairing overhead door from safety ladder; suffered attack. Fell to floor.
		FALL FROM STEPLADDER			Lost Balance			Elect. Mech.	90. To extend his reach victim stepped on hinged brace between front & back section of stepladder.
		FALL FROM SUB-STATION STRUCTURE			Slipped			Electrician	91. Installing sub-station structure; slipped and fell from steel truss. Not belted in.
		FALL FROM SUB-STATION STRUCTURE			Lost Balance			Electrician	92. Climbed onto structure from hook ladder & measured for bus; unbelted. Lost balance and fell.
MOTOR VEHICLES 14 CASES 11.7%	ON HIGHWAY 10 CASES				Collision			President	93. Company vehicle in which victim was riding struck by skidding coal truck at RR Underpass.
					Collision At Intersection			Superintendent	94. Dump truck was driven from side road into path of Company vehicle traveling on main highway.
					Struck On Sidewalk By Car			Laborer	95. Installing ornamental street light base; passing auto, out of control, jumped curb.
					Parked Company Truck Run Into			Laborer	96. Run-away truck ran into Company truck hurling victim to ground.
					Ladder Truck Double Parked Run Into			Serviceman	97. Ladder truck double parked; blinking lights on. Struck in rear by car; man thrown to street.
					Fell From Moving Truck			Maint. Man	98. Changing ornamental street light bulbs; fell off truck platform while traveling between lights.
					Tree Blown Over On Moving Truck			Groundman	99. Steel erection crew riding on truck to headquarters from job; large tree blew over on truck.
					Same as 99.			Groundman	100. See 99.
					Same as 99.			Lineman	101. See 99.
					Same as 99.			Linemen	102. See 99.
	BULLDOZER ON COAL PILE				Ran Into Steel Column			Bulldozer Oper.	103. Bulldozer ran into coal chute; went out of control; freewheeled down coal pile into column.
	PAYLOADER ON STEEP BANK				Turned Over			Pole Handler	104. Payloader working on steep bank turned over while backing.
	POLE HOLE DIGGER				Ran Away Down Hill			Machine Oper.	105. Cable holding pole hole digger broke; digger tumbled down hill into a ravine crushing victim.
	POLE HOLE DIGGER				Skidded Down Hill			Machine Oper.	106. Digging machine skidded off ice-covered road & down hill; victim jumped off in path of machine.
AIRCRAFT 1 CASE 0.8%	AIRPLANE (PATROLLING)				Crashed			Patrolman	107. Patrolling transmission line; plane crashed killing petrolman and pilot.
STRUCK BY 6 CASES 5.0%	LINEWORK				Struck By Piece Of Pole			Helper	108. Topping old pole with power saw; 2' piece thrown from pole top struck victim on head.
	LINEWORK				Struck By Falling Pole			Lineman	109. Replacing clothes pole on private property; pole fell over on victim's head.
	LINEWORK				Crushed By Rolling Poles			Line Foreman	110. Unloading carload of poles in unapproved manner; ten poles rolled off onto victim.
	TRUCK MAINTENANCE				Struck By Truck Tire			--	111. Removing outside tire from dual wheel; inside tube blew out; outside tire struck victim.
	CLEARING RIGHT-O-WAY				Struck By Tree Branch			Line Foreman	112. Branch from felled tree broke off when tree hit ground; flew thru air and struck victim.
	CLEARING RIGHT-O-WAY				Struck By Tree			Laborer	113. Cutting right-of-way; 89' tree felled by others fell on victim.
CAUGHT IN 2 CASES 1.7%	AT STATION				Caught In Conveyor Belt			Conveyor Oper.	114. Victim had just started coal conveyor belt; reason he became caught could not be determined.
	AT STATION				Caught In Conveyor Belt			Coal Handler	115. While attending coal conveyor left arm was severed when caught between snub pulley and belt.
SUFFOCATION 3 CASES 2.5%	AT STATION				Buried In Coal Bunker			Equip. Oper.	116. Cleaning bunker; coal gave way burying victim; life line not attached to safety belt.
	IN MANHOLE				Oxygen Deficiency			Mechanic	117. Nitrogen used to propel mousing device thru duct line caused oxygen deficiency in manhole.
	AT STATION				Buried In Coal Slide			Asst. Foreman	118. Caught in slide on coal pile. Carried onto conveyor belt, suffocation and spine fracture.
POISONING 1 CASE 0.8%	AT STATION				Mercury Vapor Exposure			Aux. Operator	119. Exposure to Mercury vapor during emerg. shutdown of Hg. Boiler; possible contributing cause.
CORONARY 1 CASE 0.8%	FIELD				Storm Damage Repairs			Serviceman	120. Suffered coronary occlusion while assisting in storm trouble.

Compiled for E.E.I. Accident Prevention Committee
By S. H. Young

Seven Resuscitation Awards Presented

THROUGH the EEI Resuscitation Medal, the entire electric industry is able to recognize the heroism and selflessness of those company employees who successfully restore to life an injured fellow worker. More than an individual recognition, the award also testifies to the value of a dynamic safety program for it is most frequently the preparedness achieved in these programs that enables these men to quickly and efficiently put into operation life-saving techniques.

On the following pages are summaries of resuscitation cases for which EEI Medals have been authorized and presented to the recipients since the BULLETIN last reviewed awards in February, 1955. As data on additional cases become available, they will be published in the BULLETIN.

J. B. MORRISON

Gulf States Utilities Company

On the afternoon of August 30, 1954, an extremely hot day in Beaumont, Texas, a Gulf States Utilities Co. crew under the leadership of Line Foreman J. B. Morrison was working at Ironton and Pierce Streets. Their assignment was cutting in double dead-ends on a 120-v secondary. Lineman First Class J. L. Childress and Apprentice Lineman Curtis R. Collins were working opposite one another on the pole.

Everything on the pole except the secondary neutral had been covered with rubber line hose for the men's protection. However, it was necessary for the men to slip the line hose away from the pole to install the come-along that was to hold the hot wire while it was cut and the double dead-end was installed.

Collins had fastened the come-along on his side of the pole, and reached over to assist Childress who was tying the double dead-end on his side into the insulator. Childress said he could handle the work alone, and as Collins drew his left arm back, he contacted the uncovered hot wire above his rubber glove. At the same time he apparently contacted the secondary neutral with his right arm or his chest. As Collins groaned, Childress began to slap at his arm to knock him loose. Lineman Second Class J. O. Cutler immediately climbed the pole and helped Childress tie a handline around the unconscious and not breathing victim so that other crew members could lower Collins.

Meanwhile Truck Driver J. C. Phillips had blankets and first aid equipment at the base of the pole. Other members of the crew aided in preparing Collins for resuscitation, which J. B. Morrison promptly started administering by the arm-lift method. After about three minutes the victim began to respond to the resuscitation effort, which was continued for a total of about five minutes.

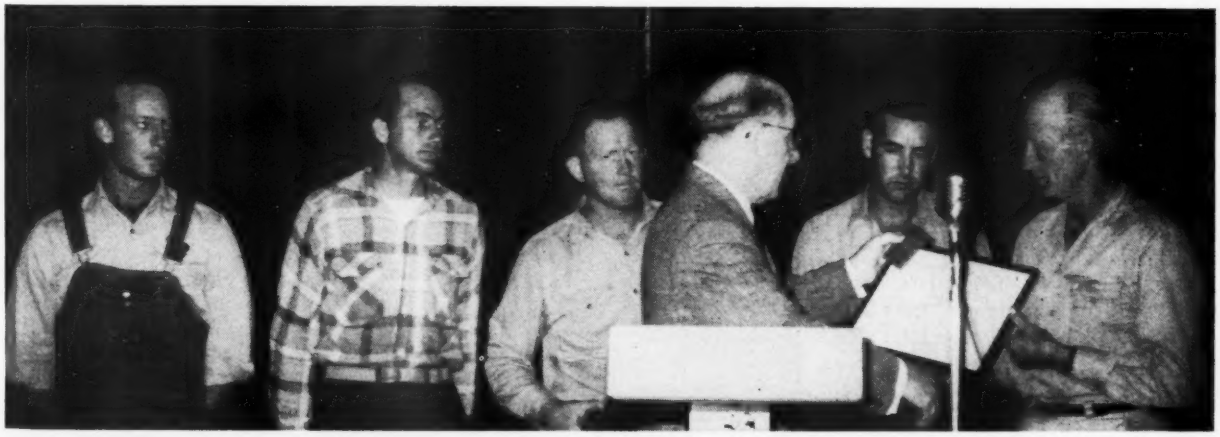
When an ambulance arrived at the scene, Helper P. D. Fontenot accompanied the victim to a hospital where Collins was treated for severe shock.

J. B. Morrison's part in the resuscitation earned for him an EEI Medal. Certificates of Assistance recognized the parts played by J. C. Phillips, J. L. Childress, J. O. Cutler, P. D. Fontenot, and Helper E. D. Shawver. Presentation of the awards was made at ceremonies held on March 14, 1955, in the company's Service Center. Approximately 200 employees and invited guests attended the event. Roy S. Nelson, President of the Gulf States Utilities Co., made the presentations. An account of the award ceremonies appeared in the Beaumont *Enterprise*.

LeROY W. BROOME

Wisconsin Power and Light Company

As part of a project of rebuilding a considerable portion of the Wisconsin Power and Light Co. system in a residential area of Beaver Dam, Wis., Line Foreman Orvin Priest's crew had been working for considerable time in an alley between Beaver and North Center Streets. On the morning of June 23, 1954, Line-



Left to right at a Gulf States Utilities Co. ceremony are Certificate of Assistance winners E. D. Shawver. J. L. Childress, and J. C. Phillips who watch as Roy Nelson, company president, in the presence of Curtis R. Collins whose life was saved, presents an EEI Medal to J. B. Morrison. Not pictured are Certificate winners P. D. Fontenot and J. O. Cutler.

Participating in EEI Medal and Certificate presentation ceremonies at Wisconsin Power and Light Co. were (left to right) Certificate of Assistance Winners Roger W. Derge and Orvin J. Priest; Paul Balfe, District Manager at Beaver Dam; EEI Medal recipient LeRoy W. Broome; Leo Colvin, whose life was saved by Broome; Wisconsin Power and Light Safety Director E. D. Ravn, and Certificate of Assistance winner George Zeltinger.

man LeRoy Broome was working atop an old pole while Lineman Leo Colvin was working on an adjacent new pole to make a transformer installation for a cut over from 2400 v delta to 4160 wye.

Colvin installed the fuse disconnect and lightning arrestor and connected them to the energized primary phase wire. He then removed his rubber gloves. In changing his position on the pole preparatory to moving down to assist Broome who was working below him, Colvin either slipped or lost his balance and in doing so placed his left hand on the energized jumper from the primary phase to the fuse disconnect. As he made contact, Colvin grunted and at the same time Priest shouted from the ground, "I think Leo is hung up."

As Broome put on his rubber gloves and transferred from the old pole to the new one to reach the unconscious and not breathing victim, Priest ran to get the rest of the crew from Burnett Street where they were working that morning. Broome grabbed Colvin, pulled on him, and broke the contact of his left hand with the primary jumper, then immediately started Oesterreich Pole Top artificial respiration. After about four or five minutes of resuscitation, Colvin regained consciousness. By that time, Groundman Roger W. Derge and Sub-station Operator George Zeltinger, who was off duty at his home nearby but who had arrived at the accident scene, had climbed the pole and tied a line around the victim preparatory to removing him from the pole. Then Broome, assisted by Priest and Derge, lowered Colvin to the ground, where he was immediately removed to a hospital. The seriousness of Colvin's burns necessitated amputation of two fingers on his left hand and three toes on his left foot. He lost approximately four months time from work.

For their resuscitation actions, LeRoy W. Broome was awarded an EEI Medal, and Orvin J. Priest, Roger W. Derge, and George Zeltinger received Certificates of Assistance. The awards were presented at Wisconsin Power and Light's annual Christmas meeting. An account of the presentation appeared in the March 3, 1955, issue of the *Wisconsin State Journal.*

GARL VANCE STERLING

Iowa Power and Light Company

It was storming during the early morning hours of August 22, 1954, near Indianola, Iowa, but a crew of Iowa Power and Light Co. was working at 3:20 a.m. near the Ackworth Sub-Station on Highway 92. The job was to replace a transformer which previously had been disconnected from the energized line.

Lineman Kenneth H. Carter had climbed the pole and belted in. He had expressed a belief that a through bolt above the transformer was long enough to attach another washer and nut, to which blocks could be hooked. As Carter changed his position, his head contacted an energized lead from the bottom of a 7200-v fuse cutout.

There was an arc and immediately Serviceman Garl Vance Sterling started up the pole, simultaneously calling to Truck Driver-Groundman Leo Cowman to call Knoxville for a doctor and ambulance. The weight of Carter's body cleared him from the energized pole. When Sterling reached the unconscious and not breathing victim, he immediately began the administration of Oesterreich Pole Top resuscitation.

Left to right: H. R. Pearson, Iowa P and L Operations Manager, is pictured with EEI Medal winner G. V. Sterling, victim K. H. Carter, and Certificate winner Leo Cowman.

Left to right: At Wisconsin Power and Light Co., Donald C. Bloom, who received an EEI Medal Miniature, Robert Van Wagenen, whose actions were recognized by a Certificate of Assistance, and Herbert R. West, who was honored with an EEI Medal, received their awards at special ceremonies held in Monroe, Wis. Participating in the ceremonies were E. D. Ravn, Safety Director for Wisconsin Power and Light; Voyta Wrabetz, Chairman of the Industrial Commission for the State of Wisconsin; Brooks J. Dunwiddie, Mayor of Monroe; Wisconsin Power and Light Vice President J. E. Canfield; Harold J. Sanders, the employee whose life was saved, and W. S. MacDonald, District Manager at Monroe.

The victim began to show signs of breathing after approximately 15 to 20 pressure strokes, but, despite the victim's struggles, resuscitation was continued for approximately five minutes. Sterling called to Cowman for a switch stick and pulled the cutouts open, then secured the blocks that were used to lower Carter to the ground. Meanwhile a passing motorist had volunteered to summon a doctor and ambulance. They were at the scene when the victim was lowered. He was removed to the doctor's office in Indianola where he was treated for shock and second and third degree burns, then was removed to a Des Moines hospital.

In recognition of their successful resuscitation, an EEI Medal was awarded to Garl Vance Sterling and a Certificate of Assistance to Leo Cowman. Presentation of the awards was made at a luncheon on February 24, 1955.

HERBERT R. WEST

Wisconsin Power and Light Company

On the afternoon of Sunday, September 26, 1954, a Wisconsin Power and Light crew, under Foreman Roy A. Speich, was working at a transformer bank on a pole platform on 18th Street in Monroe, Wis. The job was to replace three 50-kva transformers with three 100-kva transformers and install larger secondaries to serve several power customers. During the morning, the crew opened the transformer fuse disconnects and removed the hot line clamps from the 12-kv primary line to disconnect the primary risers feeding the fuse disconnects. They also removed the power secondaries from the three-phase bank and laid out new wire for the work to be done that afternoon.

After lunch, Lineman Harold Sanders again climbed the transformer bank pole and took his position on the south side of the pole close to the risers, a new position from that which he had used during the morning work. He had been working only a short time when a loud roar and flash occurred. Unconscious and not breathing, Sanders slumped in his belt toward the inside of the structure. Speich, who was supervising the work, saw Sanders made contact at that time with the primary riser feeding the center disconnect. Line Apprentice Herbert West, who was on the other pole of the same structure, saw what happened and started immediately to the aid of Sanders.

Lineman Robert W. Van Wagenen, working on a pole adjacent to the bank, came down, got a hot line cutter, and also started to aid the victim. Speich warned the men to stay away from the risers and told Van Wagenen to cut the riser which Sanders had contacted with the hot line cutter. While this was being done, West stayed on the inside of the structure, straightened Sanders up, and, after the riser was cut, started applying pole top resuscitation.

Shortly thereafter Sanders showed signs of breathing and then was lowered to the ground with a hand line. On the ground, Forestry Foreman Donald Bloom administered Holger-Nielson artificial respiration for about five minutes before a doctor, who had arrived at the accident scene, said that the resuscitation could be discontinued.

Sanders then was removed to a hospital where he was treated for first and second degree burns on his back, shoulder, and fingers of his right hand. He returned to work in about three weeks.

An EEI Medal for Herbert West, Medal Miniature for Donald C. Bloom, and a Certificate of Assistance for Robert W. Van Wagenen recognized these men's successful resuscitation actions. The awards were presented to them by Voyta Wrabetz, Chairman of the Industrial Commission of Wisconsin, at a special ceremony held in Monroe, Wis., on March 3, 1955.

D. C. Duncan, Safety Director for Appalachian Electric Power Co., presents an EEI Medal to Curtis Clifton Willis (right).

CURTIS CLIFTON WILLIS

Appalachian Electric Power Company

On September 13, 1954, a painting contractor's crew was painting a tower at Holley, W. Va., on Appalachian Electric Power Co.'s Leewood-Decota 44-kv line. The four men were applying the finishing coat of paint when one of them, Elbon Cline, apparently attempted to change positions on the steel brace on which he was sitting, and in so doing contacted with his left shoulder the energized dead-end loop on the middle phase.

There was an arc, then Cline fell approximately 34 feet to the ground. His co-workers descended from the tower, and removed the shirt and undershirt from the badly-burned victim. By this time, the Appalachian Electric Power Co. inspector, Curtis Clifton Willis, had arrived at the scene and began the administration of prone pressure artificial resuscitation. The treatment was administered for approximately 15 minutes before the victim showed any signs of life, then was continued for another five minutes before he could breathe without assistance. An ambulance then removed him to a Charleston hospital.

The victim suffered a brain laceration and injury, and severe second and third degree burns covered 50 per cent of his body. These injuries later proved fatal; however, the resuscitation effort itself was successful.

For his action, Curtis Clifton Willis was awarded an EEI Medal. Formal presentation of the award was made at a meeting of Charleston district supervisors and department heads. D. C. Duncan, system safety director, made the presentation.

An account of the presentation appeared in the June, 1955, edition of the company magazine, *The Illuminator.*

BUDDY CLYDE HICKERSON

Southwestern Gas and Electric Company

A Southwestern Gas and Electric Co. crew was working on December 8, 1954, in New Boston, Texas, to convert an old 2400-v single phase line to 7200-v grounded neutral. Two linemen, Cecil R. Clay and Buddy Clyde Hickerson, were working on a corner pole where they were pulling slack from the neutral conductor when it parted close to the pole one span away. Clay then descended the corner pole and climbed the other pole to splice the neutral. As he worked without gloves, one part of the neutral came in contact with a telephone cable, grounding the energized circuit through Clay. As he slumped in his safety belt, his groundman, R. D. Bickham, ran around the pole to pin the injured man to the pole with his hand line.

As Foreman W. E. DeVanie hurried to summon a doctor, Hickerman quickly descended the pole he was on and climbed to aid Clay. He applied Osterreich Pole Top resuscitation for approximately three minutes before the victim began to breathe, then continued the resuscitation for another two minutes. Clay was then lowered to the ground where a doctor ordered him to a hospital. There he was treated for burns.

For their resuscitation action, an EEI Medal was awarded to Buddy Clyde Hickerson and Certificates of Assistance were awarded R. D. Bickham and W. E. DeVanie. The medal and certificates were presented at a dinner held in Texarkana, Texas, on June 21, 1955.

An account of the presentation and resuscitation appeared in the Texarkana *Gazette* on June 22, 1955.

RICHARD O. JARVIS

Atlantic City Electric Company

Troubleman William H. Rocap and his helper, Richard O. Jarvis, were working on routine investigation orders and looking for actual trouble in the area served by Atlantic City Electric Co. following Hurricane "Hazel" on October 18, 1954.

Richard O. Jarvis (left) received congratulations and EEI Medal in recognition of his successful resuscitation action from B. L. England, President of Atlantic City Electric Co.

While proceeding on Delsea Drive from Port Elizabeth, south of Millville, N. J., Rocap noticed a single phase 7.2-kv lateral cutout open on a pole. After locating and clearing the source of trouble, he ascended the pole to refuse the cutout. While attempting to replace the fuse holder in the cutout, he contacted the energized line side of the cutout with his right hand.

Rocap's knees buckled but the safety belt restrained him as he slid down the pole so that Jarvis, who was working at the base of the pole, was able to catch him. Jarvis then removed the unconscious and badly burned victim's safety belt, stretched him on the ground, and began the administration of Schafer Prone Method artificial resuscitation. Jarvis continued the artificial respiration for approximately 20 minutes before he felt that he could leave the victim alone long enough to request a nearby resident to seek medical assistance.

An ambulance removed Rocap to a hospital where he was treated for third degree burns of the right forearm, hand, thumb, and index finger, and of the left forearm. Later, amputation of the right forearm proved necessary.

The EEI has recognized Jarvis's lifesaving treatment by bestowing upon him an EEI Medal, which was presented to him by B. L. England, president of Atlantic City Electric Co., before a meeting of more than 100 employees, including the victim. The February 17, 1955, edition of the Cape May County *Gazette* featured an account of the presentation ceremonies.

EEI Safety Merit Award Recognizes Baltimore Co.'s Seven Million Man-Hours Record

THE Power Transmission Stations Department of Baltimore Gas and Electric Co., whose achievement in 1953 of a total of six million man-hours of accident-free operation has stood as an industry record, has continued its outstandingly impressive safety record to establish a new industry all-time high by passing the seven million man-hour mark.

16-Year Record

The new record, recognized in one of the 17 Safety Merit Award certificates presented by the EEI during the period May 1-July 15, 1955, stands at 7,002,742 man-hours attained on June 21, 1955, less than two weeks from the sixteenth anniversary of the beginning of the accident-free period on July 3, 1939. Except for a relatively minor lost-time accident in 1939, the accident-free record of the Power Transmission Stations Department extends back for more than 23 years.

The department which made this outstanding accomplishment is composed of 217 people, although during the years in which the record was attained its number averaged 197. These people operate 116 electric substations and transmission switching stations at various levels ranging from 4 kv to 220 kv and are responsible for the maintenance of proper voltage and frequency on the company's system which serves approximately 2300 square miles.

Certificate Presentation

As a surprise feature of a regular safety meeting for representatives of the department held on August 1, 1955, Baltimore Gas and Electric Co.'s President, C. P. Crane, presented the seven million man-hour certificate to E. S. Bailey, Superindent of Power Transmission.

Six previous award certificates recognizing each of the million multiples from one through six were presented this group as employees of Consolidated Gas Electric Light and Power Co. of Baltimore, the name of which was changed to Baltimore Gas and Electric Co. effective April 1, 1955.

Other departments, divisions, and subgroups of Baltimore Gas and Electric Co. have reflected the same safety consciousness which has enabled the Power Transmission Stations Department to attain its outstanding achievement. At present within this company, in addition to the seven million man-hour award, a Safety Merit certificate for three million man-hours is held by the Electric Division, and for two million man-hours each by the Meter and Installation Department, Power Production Stations, and Electric Operations groups. In all, including these outstanding performances and 16 awards to various groups of employees for a million man-hours, Baltimore Gas and Electric Co. holds Safety Merit Award certificates recognizing 35,361,406 man-hours of accident-free operation.

Texas Achievement

The nearest runner-up to the seven million man-hour record is Texas Power & Light Co., who in August, 1954, was recognized for five million accident-free man-hours of operation by the entire company. While the Texas total does not approach Baltimore's industry-wide record, it does represent the largest number of accident-free hours of operation by any one entire company in the industry.

In addition, other companies have bettered the Baltimore Gas and Electric total of 35 million man-hours recognized by EEI Safety Merit Award certificates.

Unmistakably, however, the seven million man-hour accomplishment and the company total testify to an admirable safety-consciousness by the employees of this company. In bringing honor to themselves, they have simultaneously honored and set a challenging pace for the industry.

In commenting on the achievement, Charles P. Crane, President of Baltimore Gas and Electric Co., said:

"Our organization is trained in the belief that the highest quality service can be maintained without any compromise in matters of safety. The various departments are almost belligerently jealous of their safety records. By far the leader in our company, as well as in the industry, is our Power Transmission Stations Department under the supervision of E. S. Bailey. Their accident-free record goes back to July, 1939, and is an inspiration to other departments and, I hope, to the industry as a whole."

Four Detroit Awards

Among other EEI Safety Merit Awards presented from May 1 through July 15, 1955, four awards which total seven million man-hours were made to groups of The Detroit Edison Co. Each of these group recognitions are for periods of almost two years. Two of the awards —those to the Electrical System and Substation Department respectively —are for 3,015,255 and 2,060,343 man-hours. Five awards have been made to groups of The Detroit Edison Co. thus far in 1955.

Other awards for two million man-hours or more which are among the 17 recently presented by the EEI are to The Cincinnati Gas & Electric Co.'s Electric Distribution Department for 2,682,428 man-hours and to Consolidated Edison Co. of New York's Hell Gate Station for two million man-hours.

Awards Listed

The 17 EEI Safety Merit Awards made during the recent period are as follows:

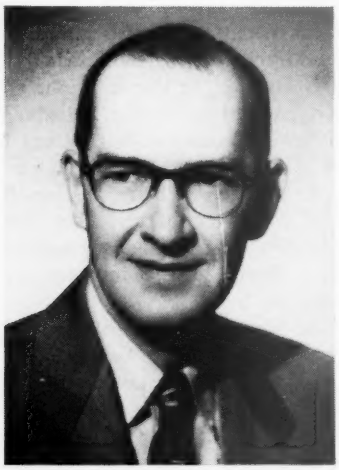
Alabama Power Co.
- Electric Operations 1,867,043
- Birmingham Division Distribution Employees...1,000,847

Baltimore Gas and Electric Co.
- Power Transmission Stations 7,002,742

(*Continued on page* 288)

Personals

Henry B. Sargent, formerly President of Arizona Public Service Co., has been elected President, a Director and Chief Executive Officer of the American & Foreign Power Co., Inc., which operates extensively in the public utility field throughout Latin America. Mr. Sargent also has been elected President of the Ebasco International Corp., the service subsidiary of Foreign Power.



HENRY B. SARGENT

His predecessor at American & Foreign Power, **W. S. Robertson,** has been elected Chairman of the Board of the company.

Following graduation from Tulane University in 1927, Mr. Sargent entered the public utility field, serving with Mississippi Power & Light Co. In 1946 he resigned as vice president and general manager of Mississippi Power & Light to join a predecessor company of Arizona Public Service Co. and has been president and general manager of the company since that time. He is a director of the American Institute of Foreign Trade, Stanford Research Institute, AGA, and a former director of EEI. He is also a vice president and director of the Pacific Coast Electrical Association.

Mr. Robertson served as president of American & Foreign Power from 1944 to the present and has been associated with the Electric Bond and Share Co. since 1916. Electric Bond and Share owns about 54 per cent of Foreign Power's common stock.

The newly-elected President of Arizona Public Service Co. is **Walter T. Lucking,** who has been a Vice President of that company since 1950. Prior to assuming the vice presidency, Mr. Lucking held the position of assistant to the president. Mr. Lucking was employed by Ohio Public Service Co. (now merged with Ohio Edison Co.) for eight years prior to joining Arizona Public Service in 1950. Earlier he served Cities Service Co., parent of Ohio Public Service Co.

HOWARD P. SEELYE

Howard P. Seelye, Manager of Engineering, The Detroit Edison Co., has retired after 29 years of service with his company.

A native of Marshall, Mich., he went to Detroit as a boy. He was first employed by Edison in 1907 in the Customer's Accounts Department.

Mr. Seelye was graduated from the University of Michigan in 1912, and re-employed at Detroit Edison in 1916 where he worked in the Distribution Engineer's Department before service in 1917-1918 as a lieutenant in the U.S. Army Coast Artillery Corps.

He rose through various positions in the company's Electrical Engineering Division to become chief engineer of the Engineering Department in 1949 and has been manager of engineering since 1952.

A specialist in system engineering planning, Mr. Seelye is the author of numerous books, among these: "The Economics of Electrical Distribution" and "Electrical Distribution Engineering." He is a regular contributor of articles to the various journals of the electric industry.

Mr. Seelye has made notable contributions to the progress of the electric industry through his outstanding work on committees of the Edison Electric Institute and professional engineering societies. He has served as chairman of the EEI Transmission and Distribution and Engineering Division General Committees. He also has effectively represented the industry in numerous joint standardization activities, including representing the Institute in the American Standards Association with work on its Electrical Standards Board and Standards Council and the co-chairmanship of the EEI-NEMA Joint Committee on Preferred Voltage Ratings.

He is a member of the Engineering Society of Detroit and a Fellow of the American Institute of Electrical Engineers.

FRANKLIN HOLLIS

Franklin Hollis, Attorney, has been elected President of Concord Electric Co. and of Exeter & Hampton Electric Co. to succeed his father, the late **Allen Hollis.**

A graduate of Harvard College and Harvard Law School, Mr. Hollis

is a member of the law firm of Sulloway, Jones, Hollis and Godfrey. In this capacity he has been most active in work for utility companies throughout New England in the matters of rate negotiations with Public Utility Commissions, finances, and labor negotiations. At present he is a member of the New Hampshire State Board of Education, having served on that Board since 1950.

L. M. Smith, President, Alabama Power Co., has been appointed Chairman of the Committee on Commercial Users of Atomic Energy for the United States Chamber of Commerce. A past president of the Birmingham Chamber of Commerce, Mr. Smith is beginning his second year as a member of the Board of Directors of the U. S. Chamber. He also serves on the National Chamber's Economic Policy Committee and the National Resources Committee.

William B. Tippy, Executive Vice President and Director, Commonwealth Services, Inc., has succeeded **Granville H. Bourne** as President of the management and engineering consulting firm. Mr. Bourne has become Chairman of the Board.

Prior to becoming associated with the predecessor of Commonwealth Services in 1945, Mr. Tippy was employed by The Detroit Edison Co., General Electric Co., and Consumers Power Co. He is an electrical engineering graduate.

Mr. Bourne was elected president of the newly-formed Commonwealth Services in 1947 after having served predecessor organizations since 1929. He has been employed in the utility field since 1906.

Ralph P. Wagner, Manager of the Niagara Mohawk Power Corp., has been named President of the Board of Governors of Albany Hospital. Mr. Wagner has been a member of the board since 1948 and has served as first vice president of the group.

Roger J. Coe, Head of the New England Electric System's Atomic Studies and Activities, has been elected a Vice President of New England Power Co.

Mr. Coe joined the company in 1926 as a distribution engineer following his graduation from Cornell University. In 1934 he became assistant electrical engineer for New England Power Service Co. Later he was named assistant to the chief engineer and in 1945 became assistant chief engineer. During World War II, he was resident engineer at Newport, R. I., for Navy construction contracts. Later, with an extended leave of absence, he served the National Defense Research Committee Transition Office in New York.

In 1950, he was loaned to the government as executive director for the Committee on Ordnance, Research, and Development in the Department of Defense.

Paul Hallingby, Jr., Assistant to the President, Middle South Utilities, Inc., has been elected a Vice President of the company.

Mr. Hallingby joined Middle South Utilities in 1952 as assistant to the president. His promotion comes at the age of 35.

A mechanical engineering graduate of Stanford University, he did graduate study at the Harvard Business School. Following his release in 1946 from active duty with the U.S. Navy as a lieutenant commander after four years service, Mr. Hallingby was employed in the investment banking field, first with First Boston Corp. and later with E. F. Hutton Co.

Two Pacific Gas and Electric Co. executives have been promoted to the positions of Vice President. They are **Shermer L. Sibley,** Engineer and Assistant to the President, who will be Vice President and Assistant General Manager, and **Robert R. Gros,** Manager of Advertising and Publicity, who as Vice President will be responsible for informational activities and special assignments by the president.

Mr. Sibley, who was graduated from the University of California in 1936, joined PG and E in 1936 as a

Rockland Light and Power Observes Lovett Plant Week

ROCKLAND Light and Power Co. recently observed the activation of its third and largest electric generating unit with Lovett Plant Week which was highlighted by a four-day open house program for company employees and the public. In raising the capacity from 48,000 to 118,000 kw, this new unit more than doubles the size of the plant.

Culminating an eight-year $25,000,000 construction project, Rockland Light and Power's 70,000-kw generating unit joins the company's two 24,000-kw generators in a triumvirate of power planned during the middle 1940's to accommodate expected increased power requirements throughout its fast-growing territory. Lovett Plant, located on the Hudson River at Tomkins Cove, N. Y., and originally known as the Hudson Steam Plant, was renamed on June 19, 1953, in memory of the late Fremont L. Lovett who had served for 26 years as general manager, vice president, director, and president of the company.

The company's Lovett Plant Week program commenced with an open house on July 14 for plant employees, followed by a two-day open house for all company employees on July 16 and 17. On the following weekend, the plant was open to the public.

Special exhibits, attendance prizes, and souvenirs were features of the open house.

The new generating unit boosts Lovett Plant capacity to a point where it can supply the requirements of 385,000 people. Operating at a steam pressure of 1850 lb and temperature of 1050 F, the new unit can generate a killowatthour of electricity from seven-tenths of a pound of coal, which makes it one of the most efficient units of its size in the world.

Coal, oil, or natural gas can be used at Lovett Plant, the fuel employed at any time depending on its relative cost. Operating at full capacity the plant will consume 300,000 tons of coal per year or 50,000,000 gallons of oil.

The plant has a coal storage area of 80,000 tons and two oil storage tanks with a capacity of 11,000,000 gallons. Cooling requires the circulation of 69,500 gallons of Hudson River water a minute or 100,000,000 gallons per day.

mapper and estimator. Positions which he has held since that time include assignments in the Department of Electric Operation and Maintenance and office assistant in the Department of the Vice President and General Manager. Since 1954, he has been assistant to **Norman R. Sutherland,** now president and general manager.

Mr. Gros taught political science at Stanford for a year following his graduation from that school in 1935. He joined PG and E in 1937 and became manager of advertising and publicity in 1944. He has developed his avocation as a commentator on national affairs to the point where he is one of the most widely known speakers of the West. Mr. Gros is a past president of the Advertising Association of the West and of the San Francisco Advertising Club, a national director of the Public Utilities Advertising Association, and recently served as executive chairman of the San Francisco civic committee in charge of the Tenth Anniversary Commemorative Session of the United Nations in San Francisco.

Named to succeed Mr. Gros as manager of Advertising and Publicity was **A. James McCollum,** who since 1946 has been the company's News Bureau Chief. Following graduation from the University of California, he taught journalism and English at Fresno State College branch in Coalinga while continuing his newspaper career begun as a boy on the Coalinga *Record,* as a sportswriter and press service correspondent. For five years he was editor of the Fresno *Guide,* resigning to enter the Navy. Mr. McCollum joined the PG and E advertising and publicity staff in 1946 and soon became the department's news bureau chief.

H. Burton Robinson, Vice President in Charge of Carolina Power & Light Co.'s Operating and Engineering Department, has been named General Manager of the company. The General Manager designation was shifted by the Board of Directors to Mr. Robinson from **Louis V. Sutton,** who continues as President and Chairman of the Board.

A director of the company since 1952, Mr. Robinson has been associated with CP&L since 1925 except for a five-year period when he was employed by Electric Bond and Share Co. He studied at Clemson College, North Carolina State College, and Massachusetts Institute of Technology before taking his first power job with Brooklyn Edison Co. Mr. Robinson worked his way through a succession of positions until 1943 when he became vice president in charge of operations and engineering. In that position, he has supervised the expenditure of more than $200,000,000 for expanded power facilities.

Lawrence M. Robertson, Sr., Chief Electrical Engineer, Public Service Co. of Colorado, received an honorary doctorate degree in engineering during the University of Colorado's commencement exercises. The degree, conferred in recognition for outstanding achievement, was based upon Mr. Robertson's work in engineering and service to the electric industry. In 1954 he was awarded the Colorado Engineering Council's gold medal award, the sixth such award to be made in the Council's 35-year history.

Safety Merit Awards

(*Continued from page* 285)

The Cincinnati Gas & Electric Co.
Electric Distribution Department 2,682,428

The Cleveland Electric Illuminating Co.
Entire Company 1,060,600
Power Production & Engineering Group 1,000,000

Consolidated Edison Co. of New York, Inc.
Production — Hell Gate Station 2,000,000

Consumers Power Co.
Flint Division..... 1,352,961

Delaware Power & Light Co.
Northern Division 2,037,441

The Detroit Edison Co.
Electrical System 3,015,255
Production Department—Marysville Power Plant. 1,001,205
Substation Department.. 2,060,343
Underground Lines Dept.—Steam & Conduit Division 1,012,535

Duquesne Light Co.
Meter Section — Substations & Shops Dept.... 1,000,453

Louisiana Power & Light Co. — Southeastern Division 1,155,731

Pennsylvania Power & Light Co.
Hazleton Service Dept.—Garage & Shops..... 1,260,061

Southwestern Public Service Co. — Plains Division.... 1,000,000

A Missing Guest

(*Continued from page* 266)

tion of costs to power and light users. Each, like others unnamed here, has made its contribution, but the one I have in mind is the first, namely: generation. For many years the power and light companies have pooled their experiences in the matter of getting more energy out of fuel. This has been a problem for trained engineers.

The economist, however, views it from a different angle. He sees purchasing power released for spending elsewhere — a phenomenon to be greatly desired throughout the industrial world. Thus it turns out that the economies flowing from improved techniques move along to the ultimate consumer in the form of relatively lower costs for the same, if indeed not better, service. In short, measured in the general price movement upward over the years, the cost of electric power and light has declined radically and is destined, in my opinion, to decline even more.

All this and more, have been done in the absence of direct competition and in the face of destructive criticism on the part of those who believe, honestly or otherwise, that such enterprises are so affected with the public interest that they should be operated by governmental agencies. Nor have our power and light companies shared in any public largess other than being permitted to operate under regulations and at a profit. Rather they have breasted unfriendly legislation setting up regulations designed to cramp their activities.

Fortunately for society in general, their offering of better service at less cost has brought its own reward. Today, I am pleased to say, much of the bear baiting of the past has disappeared never, let us hope, to return.

EDISON ELECTRIC INSTITUTE OFFICERS AND COMMITTEES

OFFICERS

HARLLEE BRANCH, JR., *President*.....Georgia Power Co., Atlanta, Ga.
D. S. KENNEDY, *Vice President*..... Oklahoma Gas & Electric Co., Oklahoma City, Okla.
H. S. BENNION, *Vice President and Managing Director*.....420 Lexington Avenue, New York, N. Y.
H. S. SUTTON, *Treasurer*.....Consolidated Edison Co. of New York, Inc., New York, N. Y.
A. B. MORGAN, *Secretary and Assistant Managing Director*..420 Lexington Avenue, New York, N. Y.

BOARD OF DIRECTORS

(Terms expiring 1956)

D. E. ACKERS.....The Kansas Power and Light Co., Topeka, Kan.
W. C. BECKJORD.....The Cincinnati Gas & Electric Co., Cincinnati, Ohio
JOSEPH M. BELL, JR.....New York State Electric & Gas Corp., Binghamton, N. Y.
WALKER L. CISLER.....The Detroit Edison Co., Detroit, Mich.
B. L. ENGLAND.....Atlantic City Electric Co., Atlantic City, N. J.
J. G. HOLTZCLAW.....Virginia Electric and Power Co., Richmond, Va.
R. K. LANE.....Public Service Co. of Oklahoma, Tulsa, Okla.
P. H. MCCANCE.....Duquesne Light Co., Pittsburgh, Pa.
R. E. MOODY.....Union Electric Co. of Missouri, St. Louis, Mo.
HARRY B. MUNSELL.....Kansas City Power & Light Co., Kansas City, Mo.
O. TITUS.....Pennsylvania Electric Co., Johnstown, Pa.
W. O. TURNER.....Louisiana Power & Light Co., New Orleans, La.
G. W. VAN DERZEE.....Wisconsin Electric Power Co., Milwaukee, Wis.
WILLIAM WEBSTER.....New England Electric System, Boston, Mass.
FRANK M. WILKES.....Southwestern Gas and Electric Co., Shreveport, La.

(Terms expiring 1957)

R. P. BRIGGS.....Consumers Power Co., Jackson, Mich.
W. J. CLAPP.....Florida Power Corp., St. Petersburg, Fla.
J. E. CORETTE.....The Montana Power Co., Butte, Mont.
C. P. CRANE.....Baltimore Gas and Electric Co., Baltimore, Md.
A. S. CUMMINS.....The California Oregon Power Co., Medford, Ore.
THOMAS G. DIGNAN.....Boston Edison Co., Boston, Mass.
E. W. DOEBLER.....Long Island Lighting Co., Mineola, N. Y.
JOHN W. EVERS.....Commonwealth Edison Co., Chicago, Ill.
C. E. IDE.....The Toledo Edison Co., Toledo, Ohio
S. R. KNAPP.....The Connecticut Light & Power Co., Berlin, Conn.
C. B. MCMANUS.....The Southern Co., Inc., Atlanta, Ga.
R. S. NELSON.....Gulf States Utilities Co., Beaumont, Texas
W. A. PARISH.....Houston Lighting & Power Co., Houston, Texas
HAROLD QUINTON.....Southern California Edison Co., Los Angeles, Calif.
L. V. SUTTON.....Carolina Power & Light Co., Raleigh, N. C.

(Terms expiring 1958)

J. L. BATES.....Central Power & Light Co., Corpus Christi, Texas
A. M. BEEBEE.....Rochester Gas & Electric Corp., Rochester, N. Y.
F. D. CAMPBELL.....Cambridge Electric Light Co., Cambridge, Mass.
C. B. DELAFIELD.....Consolidated Edison Co. of New York, Inc., New York, N. Y.
R. H. FITE.....Florida Power & Light Co., Miami, Fla.
R. H. GERDES.....Pacific Gas & Electric Co., San Francisco, Calif.
N. B. GUSSETT.....Iowa Power & Light Co., Des Moines, Iowa
E. L. LINDSETH.....The Cleveland Electric Illuminating Co., Cleveland, Ohio
D. C. LUCE.....Public Service Electric & Gas Co., Newark, N. J.
M. S. LUTHRINGER.....Central Illinois Public Service Co., Springfield, Ill.
C. E. OAKES.....Pennsylvania Power & Light Co., Allentown, Pa.
H. T. PRITCHARD.....Indianapolis Power & Light Co., Indianapolis, Ind.
K. M. ROBINSON.....The Washington Water Power Co., Spokane, Wash.
L. M. SMITH.....Alabama Power Co., Birmingham, Ala.
HAROLD TURNER.....American Gas and Electric Co., New York, N. Y.

Executive Committee

W. L. Cisler, C. B. Delafield, E. L. Lindseth, D. C. Luce, C. E. Oakes, Harold Quinton, L. V. Sutton, G. W. Van Derzee, William Webster.

EDISON ELECTRIC INSTITUTE OFFICERS AND COMMITTEES

ADVISORY COMMITTEE 1955-1956

D. C. BARNES.....Virginia Electric and Power Co.
A. D. BARNEY.....The Hartford Electric Light Co.
J. B. BLACK.....Pacific Gas and Electric Co.
EDGAR H. DIXON.....Middle South Utilities, Inc.
PHILIP A. FLEGER.....Duquesne Light Co.
GEORGE M. GADSBY.....Utah Power & Light Co.
WILLIS GALE.....Commonwealth Edison Co.
ALLEN S. KING.....Northern States Power Co.
H. P. LIVERSIDGE.....Philadelphia Electric Co.
J. E. LOISEAU.....Public Service Co. of Colorado
GEORGE L. MACGREGOR.....Texas Utilities Co.
EARLE J. MACHOLD.....Niagara Mohawk Power Corp.
J. W. MCAFEE.....Union Electric Co. of Missouri
LYLE MCDONALD...Public Service Electric and Gas Co.
PAUL B. MCKEE.....Pacific Power & Light Co.
I. L. MOORE.....New England Electric System
W. C. MULLENDORE....Southern California Edison Co.
GROVER C. NEFF.....Wisconsin Power and Light Co.
J. S. OSBORNE.....Central & South West Corp.
WALTER H. SAMMIS.....Ohio Edison Co.
H. R. SEARING.....Consolidated Edison Co. of New York, Inc.
MCGREGOR SMITH.....Florida Power & Light Co.
PHILIP SPORN.....American Gas and Electric Co.
FRANK M. TAIT.....The Dayton Power and Light Co.
J. B. THOMAS.....Texas Electric Service Co.
E. S. THOMPSON....The West Penn Electric Co. (Inc.)
J. R. WHITING.....Consumers Power Co.

CHAIRMEN OF EDISON ELECTRIC INSTITUTE COMMITTEES (1954-1955)

ACCOUNTING

Accounting Division Executive, O. K. BOYD.....Baltimore Gas and Electric Co., Baltimore, Md.
Coordinator of Customer Activities, F. J. PORTER, JR.....Consolidated Edison Co. of New York, Inc., New York, N. Y.
Customer Accounting, S. A. COLE.....New York State Electric & Gas Corp., Ithaca, N. Y.
Customer Collections, A. H. MAYER.....Consolidated Edison Co. of New York, Inc., New York, N. Y.
Customer Relations, T. J. PETERSON.....The Detroit Edison Co., Detroit, Mich.
Coordinator of General Activities, W. T. HAMILTON.....The Cleveland Electric Illuminating Co., Cleveland, Ohio
Depreciation Accounting, C. N. RICE, JR.....Northern States Power Co., Minneapolis, Minn.
General Accounting, C. T. DWIGHT.....The Hartford Electric Light Co., Hartford, Conn.
Internal Auditing, G. G. BECHER.....The Dayton Power and Light Co., Dayton, Ohio
Plant Accounting and Records, F. W. ROSS.....Pennsylvania Power & Light Co., Allentown, Pa.
Taxation Accounting, C. A. PALMGREN, JR.....New Orleans Public Service, Inc., New Orleans, La.

COMMERCIAL

Commercial Division Executive, O. R. DOERR.....Pacific Gas and Electric Co., San Francisco, Calif.
Commercial Sales Group, R. W. BUTTS.....Ohio Edison Co., Akron, Ohio
Farm Group, BUD S. MOSS.....Georgia Power Co., Atlanta, Ga.
Industrial Power and Heating Group, G. S. YOUNG.....Kansas City Power & Light Co., Kansas City, Mo.
Residential Group, H. H. BRENAN.....Pennsylvania Power & Light Co., Allentown, Pa.
Special Service Group, F. C. PESVEYC.....Public Service Electric and Gas Co., Newark, N. J.

ENGINEERING

Engineering Division General, E. L. HOUGH.....Union Electric Co. of Missouri, St. Louis, Mo.
Electrical Equipment, C. L. DERRICK.....The Hartford Electric Light Co., Hartford, Conn.
Hydraulic Power, P. M. HESS.....Pennsylvania Water & Power Co., Lancaster, Pa.
Meter and Service, C. V. MOREY.....Consolidated Edison Co. of New York, Inc., New York, N. Y.
Prime Movers, W. L. CHADWICK.....Southern California Edison Co., Los Angeles, Calif.
Transmission and Distribution, J. W. ANDERSON.....Philadelphia Electric Co., Philadelphia, Pa.

GENERAL

Accident Prevention, R. P. DOUGLAS.....The Detroit Edison Co., Detroit, Mich.
Area Development, W. I. DOLBEARE.....Virginia Electric and Power Co., Richmond, Va.
Atomic Power, EDGAR H. DIXON.....Middle South Utilities, Inc., New York, N. Y.
Codes and Standards, E. W. DOEBLER.....Long Island Lighting Co., Mineola, N. Y.
Electric Power Survey, ARTHUR S. GRISWOLD.....The Detroit Edison Co., Detroit, Mich.
Financing and Investor Relations, H. A. BUSCH.....General Public Utilities Corp., New York, N. Y.
Industrial Relations, F. R. RAUCH.....The Cincinnati Gas & Electric Co., Cincinnati, Ohio
Insurance, WALTER O. RANDLETT.....Virginia Electric and Power Co., Richmond, Va.
Legal, D. BRUCE MANSFIELD.....Ohio Edison Co., Akron, Ohio
Membership, E. S. THOMPSON.....The West Penn Electric Co. (Inc.), New York, N. Y.
Prize Awards, HARRY RESTOFSKI.....West Penn Power Co., Pittsburgh, Pa.
Purchasing and Stores, J. D. HOGG.....The Cleveland Electric Illuminating Co., Cleveland, Ohio
Rate Research, C. A. WILLIAMS.....The United Illuminating Co., New Haven, Conn.
Regulation, HARLLEE BRANCH, JR.....Georgia Power Co., Atlanta, Ga.
Research Advisory, R. E. MOODY.....Union Electric Co. of Missouri, St. Louis, Mo.
Research Projects, C. W. FRANKLIN.....Consolidated Edison Co. of New York, Inc., New York, N. Y.
Statistical, ROY F. CRIM.....West Penn Power Co., Pittsburgh, Pa.
Tax Policy, R. P. BRIGGS.....Consumers Power Co., Jackson, Mich.
Technical Exchange for Overseas Visitors, HARVEY E. BUMGARDNER.....The Detroit Edison Co., Detroit, Mich.
Transportation, RANDOLPH WHITFIELD.....Georgia Power Co., Atlanta, Ga.

Gas Co.
ght Co.
System
son Co.
ght Co.
st Corp.
son Co.
ison Co.
ork, Inc.
ight Co.
tric Co.
ight Co.
vice Co.
. (Inc.)
wer Co.

ore, Md.
k, N. Y.
a, N. Y.
k, N. Y.
t, Mich.
nd, Ohio
s, Minn.
d, Conn.
on, Ohio
own, Pa.
eans, La.

o, Calif.
on, Ohio
nta, Ga.
ity, Mo.
own, Pa.
k, N. J.

uis, Mo.
d, Conn.
ster, Pa.
k, N. Y.
es, Calif.
phia, Pa.

t, Mich.
ond, Va.
k, N. Y.
a, N. Y.
t, Mich.
k, N. Y.
ati, Ohio
ond, Va.
on, Ohio
k, N. Y.
urgh, Pa.
nd, Ohio
n, Conn.
nta, Ga.
uis, Mo.
rk, N. Y.
urgh, Pa.
n, Mich.
it, Mich.
nta, Ga.